SCIENTIFIC AMERICAN

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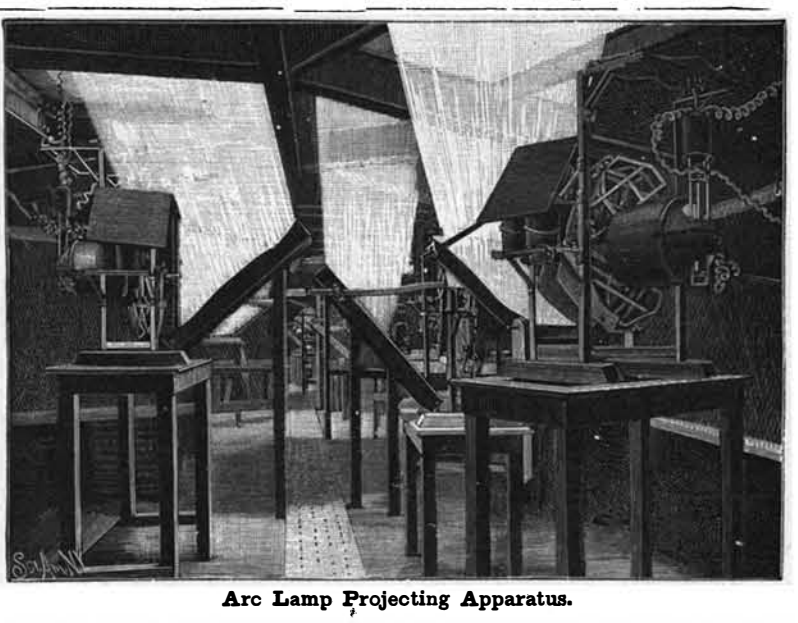
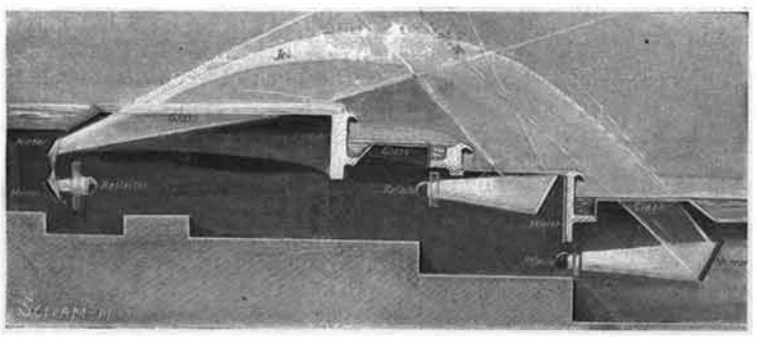
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 15. ESTABLISHED 1845. NEW YORK, OCTOBER 13, 1900. $3.00 A YEAR. WEEKLY.

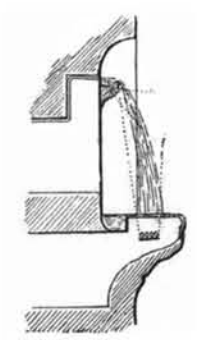
Palace of Machinery, Showing Basin and Luminous Fountains.



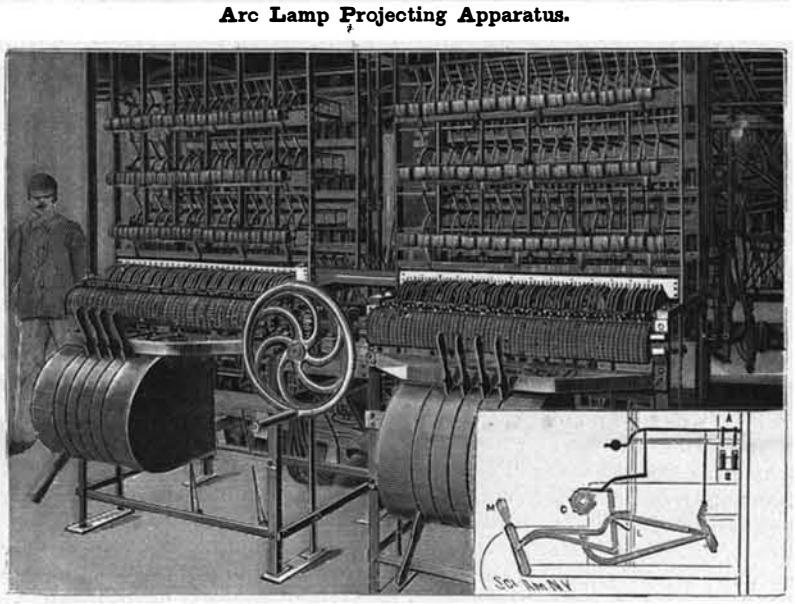
Arc Lamp Projecting Apparatus.



Lighting of Parabolic Jets.



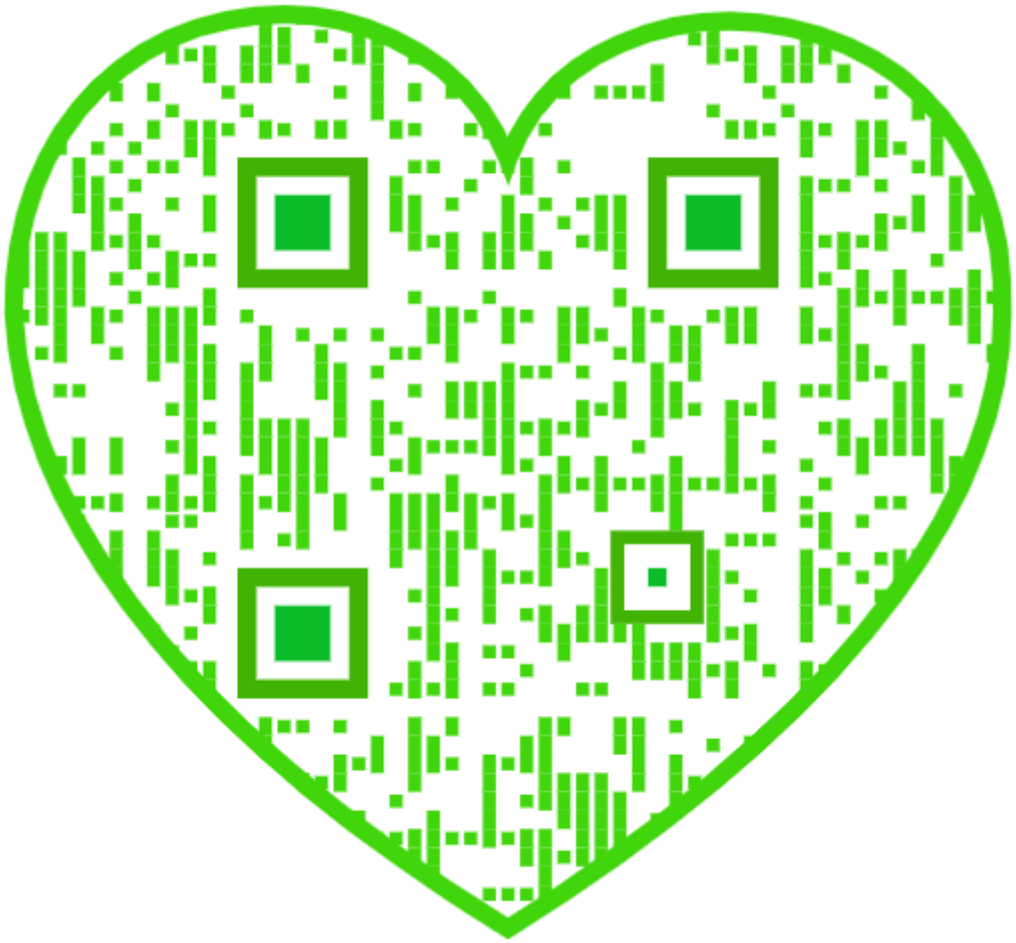
Cascade Lighting.



The "Jeu d'Orgue," or Arc Light Controlling Drums.

Façade of the Palace of Electricity, Showing the Château d'Eau and Luminous Fountains.

THE PARIS EXPOSITION—THE ELECTRICAL FOUNTAINS OF THE PALACE OF ELECTRICITY.—[See page 231.]



Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
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MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, OCTOBER 13, 1900.

EXTENSION OF THE RAPID TRANSIT TUNNEL TO BROOKLYN.

One of the most important steps ever taken in connection with the scheme for underground rapid transit in New York is the adoption by the Rapid Transit Board of the route and plans for the construction of the system to Brooklyn by means of a tunnel beneath the East River. The plan contemplates the extension of the tunnel from its present proposed terminus at City Hall Park to Bowling Green, and thence by way of Whitehall Street to the East River. The line will be carried below the river from the foot of Whitehall Street to the foot of Joralemon Street, Brooklyn, beneath which it will run as far as the City Hall, where there will be a station. From the City Hall it will be carried beneath Fulton Street to Flatbush and Atlantic Avenues, which will constitute the present terminus of the line. That section of the extension which lies beneath the river, together with its approaches on either side, will consist of two 15-foot cast iron tubes which will provide two separate tunnels, one for each track. At the Brooklyn City Hall two loops will be constructed, one above the other. Of these, one will be used for the New York trains, and the other will be built in anticipation of the time when the development of underground tunnels in Brooklyn will call for the running of local trains. The new plan also contemplates another loop on the New York system, which is to commence beneath Broadway, near Exchange Place, and be carried beneath Bowling Green, State Street, Battery Park, and Whitehall Street, returning to Broadway. The length of the Brooklyn extension will be 4½ miles, of which about a mile and a half will be of cast-iron tube construction. It is estimated that the trip from one city hall to the other will occupy eight minutes.

In view of the fact that it is probable that delays incidental to obtaining the authority of the Municipal Assembly and the approval of property owners will prevent the commencing of work on this extension for twelve months or more, the Rapid Transit Board is to be congratulated on having so promptly adopted the plans of its chief engineer. There is no question of the wisdom of extending the New York tunnel to the southern extremity of Manhattan Island; and no system of rapid transit designed for the accommodation of Greater New York would be adequate that did not include the Borough of Brooklyn and rapidly growing suburbs of Long Island. The natural features of the site on which New York is built render it inevitable that ultimately the great tide of suburban home-seekers will flow out on to Long Island, in preference to moving over the congested roads of travel which extend northward through Manhattan Island. While the completion of the underground tunnel will lead to the rapid settling up of the suburban districts north of the Harlem River, the accessibility of the Boroughs of Brooklyn and Queens is certain to attract an enormous number of home-seekers, when once the travel on the Brooklyn Bridge has been relieved by the construction of the new rapid transit tunnel to the south, and the new East River Bridge to the north, of that overcrowded structure.

RAILROAD SPEEDS IN 1899.

In a recent letter to The London Times, a correspondent, who has evidently gone into the subject with great care, has compiled several tables, showing the fastest trains, the distances they run, and their speeds, on the leading railroads of the world. The tables will be in some respects particularly gratifying to American readers, although it must be confessed that in respect to the total number of fast long-distance trains, France, which of late years has made wonderful strides in the development of her railroads, easily holds the premier position. Under the table of the fastest booked speeds, from start to stop, this country heads the list with four notable trains which are run on the Philadelphia and Reading and Pennsylvania Railroads, from Camden to Atlantic City. The two Philadelphia and Reading trains cover the distance of 55½ miles at the rate of 66·6 miles an hour, while the two Pennsylvania Railroad trains run between the same points a distance of 59 miles at the rate of 64·3 miles an hour. Following these is a French train, which runs the distance from Morceux to Bordeaux, 67¾ miles, at the rate of 61·6 miles per hour, and next to this are four trains on the Camden-Atlantic City lines, with speeds of 61 and 60·5 miles an hour. Then follows a train on the Paris-Amiens route, which covers 81¾ miles at a speed of 60·5 miles an hour. The next two fast runs are short ones of 15 miles from Dorchester to Wareham in England, which are booked to be made at a speed of 60·1 miles an hour. It is a significant fact that out of forty-three expresses, with a speed of over 55·5 miles an hour, these Dorchester-Wareham trains and three trains on the Caledonian Railroad, two of which cover 32½ miles at 59·1 miles an hour and 56·5 miles an hour, and the third, 89¾ miles at 55 6 miles an hour, are the only ones that represent the English railroads; although it is but a few years ago that English roads were supreme in the matter of speed among the railroads of the world. Out of a total of 57 trains given in this table, there are only three other English trains which have a speed of 55 miles an hour or over. Summing up, we find that America heads the list in point of speed, with twenty-three trains, while France has twenty-six trains and England eight in the table referred to.

The credit for running the fastest long distance train in the world is due to the Orleans and Midi Railroad, whose train from Paris to Bayonne, a distance of 486¼ miles, is run at a speed, including six stops, of 54·13 miles an hour. This is better than the Empire State Express, which runs from New York to Buffalo, 440 miles, at a rate, including four stops, of 53·33 miles an hour. The best work of the English railroads is that done on the Great Northern from King's Cross to Edinburgh, a distance of 393½ miles, which is covered at an average speed, including three stops, of 50·7 miles per hour.

We have said that by virtue of the high average speed and great number of its long-distance express trains, France holds the premier position to-day, a statement which is borne out by the fact that there are thirteen expresses which are booked to run at average speeds, including stops, of from 51·3 to 57·7 miles per hour, over distances of from 123 to 486¼ miles. The fastest of these, which runs from Bayonne to Bordeaux, covers a distance of 123 miles at 57·7 miles per hour, with two stops; while the most creditable run is one from Paris to Bayonne, of 486¼ miles, at 54·1 miles an hour, above referred to. The letter to the Times, with its valuable tables, will be found in full in the current issue of the SUPPLEMENT.

Commenting upon this very interesting and impartial communication, The Engineer and Engineering have taken very different and very characteristic points of view. Engineering accepts the situation with the remark that it is "mortifying to observe what an extremely poor show is made by Great Britain in a field in which she was long pre-eminent," and adds that "if we take into account the special conditions in each case, the American performances are made to appear even more extraordinary than is at first apparent." The Engineer, on the other hand, states that "the occasion has been seized as a favorable opportunity for drawing invidious comparisons between the railways of the United States and of this country." The latter contemporary takes occasion to felicitate itself on the fact that "it has done something to prevent the perpetuation of the preposterous statements as to enormous speeds attained on American railways." In view of the fact that the speeds as given are absolutely correct, there is something highly diverting to American readers of The Engineer in the persistency with which it has endeavored to escape from facts which have long been recognized by the world at large.

THE WORLD'S NAVAL PROGRESS FOR 1900.

The most important contribution, and the one possessing the most popular interest, in "Notes on Naval Progress for 1900," which have recently been published under the direction of Capt. C. B. Sigsbee, chief intelligence officer of the navy, is an article by Lieut. Wm. M. Howard, entitled "Increase in Naval Strength as shown by the Naval Budgets." One cannot turn over the pages of this work without feeling that there is little evidence that the feverish naval activity of the past few years is abating. A study of the budgets and programmes of construction of the various naval powers indicates that in the early years of the coming century the great navies of the world will continue to add to their fleets with increasing rapidity.

As usual, it is Great Britain which leads the way by voting the largest sum of any of the Powers for the support and increase of her navy. So rapid, however, has been the growth of other navies which may at any time become her combined opponents, that the progressive element in naval affairs in that country considers that the Admiralty programme for this year is altogether inadequate. In laying it down as the principle for her guidance that the British navy must be more than equal to any other two navies combined, England has set herself a truly stupendous task, the magnitude of which can best be appreciated when we look at the extraordinary development taking place in the German, French, and Russian navies. The British programme calls for the laying down this year of two battleships, six first-class armored cruisers, one second-class cruiser and half a dozen sloops, gunboats and torpedo boats. Including these, the number of vessels under construction in 1900 is seventeen battleships (only one less than the total number of battleships already constructed, building, or proposed for our own navy), twenty armored cruisers, one first-class protected cruiser, two second-class protected cruisers, one third-class cruiser, eight sloops, four torpedo boats, twenty-one destroyers, and one royal yacht. In 1899, England added nineteen vessels with an aggregate tonnage of 122,322 tons to her fleet, while in 1898 she added thirty ships with a total tonnage of 140,988 tons. This year's budget provides for an increase of 4,240 in the personnel; an addition which will bring the total strength up to 114,880 officers and men. The total naval estimates for the year 1900–1901 amounted to $137,613,000.

The French shipbuilding programme of 1896, which covered a period extending to 1907, called for the construction of 220 vessels. In addition to this, the programme for this year authorizes the construction of the following types of vessels, which are considered necessary to render the French fleet more homogeneous than it is at present: Six battleships, five armored cruisers, twenty-eight destroyers, one hundred and twelve torpedo boats, and twenty-six submarine torpedo boats. When the programme is completed, the French fleet will consist of twenty-eight battleships, twenty-four armored cruisers, fifty-two destroyers, two hundred and sixty-three torpedo boats and thirty-eight submarine boats. The total cost of the old and the additional programme will be $142,440,000.

The expressed determination of Germany to become a great naval power lends particular interest to that part of the report which deals with her navy. The policy of the Emperor is "to provide the German empire with a navy so strong that no power will dispute with her upon the high seas." Although there is considerable opposition to the bill to carry into effect the latest proposals for an increase, it is pointed out in the report that even if these proposals should fail to be put through, the programme as already authorized insures possession by Germany in the early part of the coming century of an extremely powerful fleet. In 1900 it consists of seventeen battleships, ten large cruisers, twenty small cruisers, twelve divisions of torpedo boats. In 1908 Germany will possess twenty-nine battleships, twenty large cruisers, fifty-one small cruisers, and sixteen divisions of torpedo boats; while in 1916 she will possess thirty-eight battleships, twenty large cruisers, forty-five small cruisers and sixteen divisions of torpedo boats.

The naval budget of Italy for the year 1900–1901 amounts to $24,435,000, while an annual expenditure of $2,000,000 has been authorized for the period ending in 1903. Italy has at present on the stocks four first-class battleships, three armored cruisers, three small cruisers, ten destroyers, and three first-class torpedo boats, in addition to two first-class battleships of what is known as Admiral Bettolo's naval programme.

The activity of Japan is shown in the fact that the 117 warships called for by the naval programme of 1895 have been completed, or are under construction, and it is likely that a new programme will shortly be laid down. The budget for 1900 calls for the expenditure of $46,946,000.

Russia, like Germany and France, has now formulated a programme of naval construction. The sum of $45.000,000 was voted in 1898 for the completion in six years of ten armored cruisers, ten second-class cruisers, and twenty destroyers. This was a special programme, additional to the regular annual naval estimates. Although Russia's naval budget has increased from $29,000,000 in 1897 to $45,000,000 in 1900, it is reported that the government will shortly announce a new programme for the increase of her fleet.

Spain is selling her obsolete warships, and with the money thus secured two vessels of about 2,000 tons displacement are to be constructed and used for the training of officers and men. The money voted under the budget of this year is to be spent in completing and increasing the crews of the "Pelayo," "Carlos V.," "Numancia," "Vittoria," and "Nautilus."

Comparing our own progress with that of the other naval powers, it is evident that there must be no relaxation in our naval activity. Although we have not laid down programmes of construction extending over several years, our present system of authorizing a certain number of ships each year, if maintained at the rate which has marked our recent progress, will enable us to retain our position as fourth naval power; but it is evident that any relaxation, such as would be caused by the failure of Congress to vote naval appropriations in any particular year, would cause us to lose our present creditable standing.

CULM BANKS AND FUEL GAS.

BY ALTON D. ADAMS.

Near the mines of hard coal, great mounds of anthracite culm have accumulated. This culm or very finely divided coal continues to pile up from year to year, because its value in coal markets is not sufficiently great to cover the transportation charges. So great have the quantities of this fine coal become that it is an impediment to mining operations, and the owners would gladly see it removed without asking any compensation. While these little mountains of culm are oxidizing, unprotected from the action of rain and sun, the demand for cheaper gas in heating and industrial operations is daily increasing at cities only a few tens or a few scores of miles distant. The minds of those familiar with these facts have often turned to the idea that in some way the energy wasting in these mounds of fine coal might be gathered up in gas and transferred through pipes to distant points of use. Such plans have not yet gone beyond the interrogation point, Will it pay? and little seems to have been done in the way of an answer to this important question. The controlling factor in the problem is evidently one of transportation. Though culm cannot be handled, transported and delivered to consumers at a profit, it is possible that a gas containing a part of the coal's energy may be transmitted through a pipe to more advantage. While experience has nothing to offer on just the case in hand, some of its lessons may be drawn from similar instances. It is known that natural gas has been and is successfully transmitted through pipes over distances as great as one hundred miles. Petroleum is also economically transferred long distances through pipes, and there seems to be ample precedent for their use where available from the financial standpoint. It may be accepted without argument that culm would be valuable, were the costs of transportation eliminated, and it therefore remains to be discovered whether these costs can be so reduced in gas pipe lines as to render the energy of this now refuse coal available.

Most of the expense of gas transfer through a long pipe line arises from the items of interest and depreciation on the cost of construction, a smaller amount being due to the development of power to pump the gas. The capacity of a gas pipe line and the cost of pumping the gas depend on the weight and volume to be moved per hour or other unit of time, but the value of the gas varies directly with its heating capacity on combustion. If the energy of culm is to be cheaply transmitted in gas, it is, therefore, highly important that the kind of gas to which the energy of coal is transferred shall have as little weight and as large a heating capacity per cubic foot as possible. Since the culm now considered has no present value and its removal free of charge will be a benefit to the present owners, the efficiency of the gas-making process adopted is not nearly so important as is the quality of the gas produced. There are two well-known processes for the production of gas from anthracite coal, known as the producer and the water-gas methods respectively. Two thousand pounds of anthracite coal yield on treatment about 160,000 cubic feet of producer gas. This gas develops on combustion fully 125 heat units per cubic foot or a total of 20,000,000 heat units. Allowing 12,500 heat units per pound for the heating capacity of the coal, the energy of one ton is 25,000,000 heat units. The producer gas process therefore delivers 80 per cent of the heating power of coal. Water gas to the amount of 33,333 cubic feet may be generated with one ton of anthracite coal, and each cubic foot of gas has a capacity to develop 325 heat units. The 33,333 cubic feet of water gas therefore represent 10,833,225 heat units, or a little more than 40 per cent of the energy of the coal. Producer gas, therefore, makes available nearly twice as much of the heating power of coal as does water gas.

The water gas, however, has about two and one-half times as much heating capacity per cubic foot as that from the producer, and this has an important influence on the cost of a pipe line and on the subsequent power for pumping. Producer gas has approximately 0·84 and water gas 0·57 as much weight as air per cubic foot, or, in other words, the weight of producer gas is 65 pounds and of water gas 45 pounds per 1,000 cubic feet. To supply a heating capacity equal to that of one cubic foot of water gas, 2·6 cubic feet of producer gas are required, and the weight of this amount of producer gas is 3·75 times as much as the weight of the single cubic foot of water gas. This great difference in weight and volume for a given heating capacity is inherent in the compositions of producer and water gas. More than one-half, or 55 to 60 per cent of the producer gas, as to both weight and volume, is composed of nitrogen and inert gas that has no fuel value.

Water gas, on the other hand, contains only 2 or 3 per cent of nitrogen, while nearly 90 per cent of its weight and volume is a mixture of hydrogen and carbon monoxide, both excellent fuels. The facts just cited indicate the decided advantage of water gas over producer gas, as to the weight and volume of each that must be forced through a pipe line per unit of time, for a given heating capacity. The greater the volume and weight of gas moved past any section of the pipe per hour, the larger and more expensive must be the pipe line, or the power required to maintain the flow. Figures for an assumed case of gas transmission, to a given distance and for a certain heating and power capacity, covering the size and approximate cost of the pipe line, will perhaps best illustrate what can be done. For the purpose of this example, the water gas above described will be employed. It may be stated that the water gas here mentioned is quite different from the so-called water gas commonly distributed in cities for purposes of illumination. The heating and illuminating power of plain water gas is usually much increased by the addition of oil gas from petroleum or naphtha before distribution for general use. Plain water gas is entirely suitable for heating and power purposes, also for illumination if incandescent gas mantles are used.

The open flame of pure water gas has very little illuminating power, but water gas from a distant works could be readily mixed with hydrocarbon gases from petroleum, if desired for purposes of illumination in open flame burners. Maps of the United States show quite a number of cities not more than fifty miles distant from the anthracite coal fields, in each of which a yearly consumption of 700,800,000 cubic feet of water gas may readily be expected. This amount of plain water gas is the equivalent in heating capacity of 350,400,000 cubic feet of coal gas or carbureted water gas, or of 9,110 tons of coal. Owing to the low efficiency of ordinary heating and cooking apparatus, where coal is used, the 700,800,000 cubic feet of plain water gas would be the practical equivalent of 20,000 to 40,000 tons of coal for general purposes. The amount of water gas just named as a yearly consumption corresponds to an average constant hourly flow from the pipe line of 80,000 cubic feet. During a year of 3,000 working hours this flow of gas would supply gas engines with a total capacity of 5,840 horse power, allowing 40 cubic feet of gas per brake horse power hour. A pipe of twelve inches internal diameter will deliver this water gas from a distance of fifty miles at the rate of 80,000 cubic feet per hour, if supplied at a pressure of 45 pounds per square inch. To pump the gas through this pipe at the rate and pressure just named requires 300 horse power. The plant to furnish this power should be located at the gas works near the coal mines, and should operate continuously during each twenty-four hours.

The yearly cost per horse power at such a plant, considering its location and the cheap fuel, may be taken at $30 or $9,000 as a total. Fifty miles of wrought iron or steel pipe, 12 inches in diameter, with sides 0·083 inch thick, and a safe working strength nearly four times as great as the proposed gas pressure, weighs 1,848 tons. A liberal estimate for the cost of this pipe, including the laying and connection in position, is $200,000. Annual interest, depreciation and repairs at 15 per cent on this sum, amounting to $30,000, is a sufficient allowance for these items. The total yearly charge for the transmission of 700,800,000 cubic feet of gas is, therefore, $39,000. This is equivalent to a cost of 5·6 cents for each 1,000 cubic feet transmitted. As the prime incentive to the transmission is the cheap or worthless fuel near the mines, the cost of the transmission should be compared with the value of the coal consumed per 1,000 cubic feet of a plain water gas produced at the ordinary city gas works. At the rate previously stated of 33,333 cubic feet of plain water gas produced per ton of coal consumed, 60 pounds of coal are required to generate 1,000 cubic feet of the gas. Of this 60 pounds, about 50 pounds must be anthracite coal for use in the gas generators, but the remaining 10 pounds may be bituminous coal for use under the boilers that supply steam to the generators. Assuming $4 per ton as an average price for all of the coal, the 60 pounds consumed to generate 1,000 cubic feet of plain water gas costs 12 cents. As the total charge against 1,000 cubic feet of gas was found to be 5·6 cents for transmission over a distance of 50 miles from a place of free fuel, the expense for coal at $4 per ton is more than twice as great as the charge for transmission. With anthracite coal at $2 per ton, its cost per 1,000 cubic feet of gas generated at city works is just about equal to the charge for transmission of the same amount of gas over a distance of 50 miles.

The estimates just made are for a transmission of 50 miles, but the costs for the same quantity of gas over any other distance can be readily derived from them. All of the expenses of the transmission vary directly as the distance, provided that other factors remain constant. If the pipe line is extended to a length of 100 miles, the weight and cost of pipe is twice as great, and the required power is twice as great, for the same delivery of gas. For the line of 100 miles the cost of transmission per 1,000 cubic feet of gas is therefore 11·2 cents, or nearly the value of the coal from which the gas may be generated when it is worth four dollars per ton. If the distance of the transmission is only 25 miles, the cost per 1,000 cubic feet of gas drops to 2·8 cents and is equivalent to that of anthracite coal at one dollar per ton. Inspection of the items in the transmission estimate shows that more than three-fourths of the total are for interest, depreciation and repairs, and about one-fourth for power. This indicates that the transmission charge could be reduced by a smaller investment in pipe line and the use of more power for pumping the gas. As the flow of gas is presumed to be continuous, gas holders must be provided at both ends of the line, but their combined capacities need be no greater than for the case of a city gas works of equal capacity. Including the cost of the plant for pumping gas, estimated at $30,000, to that of the pipe line gives a total of $230,000. The 80,000 cubic feet of gas delivered per hour are competent to develop 2,000 horse power during 24 hours per day, on an investment of $115 per horse power for the transmission equipment. This supply of gas can develop heat energy that is equivalent to 7,620 kilowatts at an investment of only $30 per heating capacity equivalent to one kilowatt.

THE NOBEL PRIZES FOR SCIENTIFIC DISCOVERIES.

Many of our readers will be interested to know that the formal rules and regulations relating to the awarding of prizes under the Nobel bequest have now been formulated and published, and in the SUPPLEMENT for the current week we give them in full. The three corporations awarding the Nobel prizes are the Royal Academy of Science at Stockholm, the Swedish Academy at Stockholm, and the Carolin Institute of Medicine and Surgery at Stockholm. The first award will take place December 10, 1901. The prizes are assigned as follows: 1. To the person having made the most important discovery or invention in the department of physical science. 2. To the person having made the most important discovery and having produced the greatest improvement in chemistry. 3. To the author of the most important discovery in the department of physiology or medicine. 4. The author having produced the most notable literary work in the sense of idealism. 5. To the person having done the most, or the best, in the work of establishing the brotherhood of nations, for the suppression or the reduction of standing armies, as well as for the formation and the propagation of peace conferences.

For physical science and chemistry the Swedish Academy of Science will award the prize. For works in physiology or medicine, the Carolin Institute will give the prize; for literature, the Academy of Stockholm: and finally, for the work of peace, by a committee of five members elected by the Norwegian Stortung. It is expressly stipulated in Dr. Nobel's will that nationality shall not be considered, so that the prizes may accrue to the most worthy without consideration as to place of birth. The matter of the estate has been satisfactorily adjusted with the Nobel heirs. Each of the annual prizes given by the will must be awarded at least once in the course of every period of five years, and the sum total of a prize thus awarded shall in no case be less than 60 per cent of the yearly revenues diposable for the distribution of the prizes; neither can it be divided into more than three prizes at the most. The limitation of the will declaring that the annual distribution of the prizes must be directed to works executed in "the course of the preceding year" must be interpreted in this sense, that the objects of the rewards shall be the most recent results of research displayed in the departments indicated by the will; older works will be considered only in the event that their importance shall have been demonstrated in recent times.

In order to be admitted to the competition, every written work must have been published by means of the printing press. Various regulations have been made relative to the division of the prizes, and as to whether the prizes may be adjudged to an institution or a society. If none of the works submitted to the competition possess the quality desired, the sum total of the prize is reserved for the following year. For admission to the competition it is necessary to be proposed in writing by a qualified person, and no attention will be paid to requests addressed by persons desiring to obtain a prize themselves. At the annual competition an annual committee considers proposals which have been offered in the course of the year immediately preceding, up to the date of February 1. Each proposal must be accompanied by writings and other documents upon which it is founded. The proposal must be drawn up in English, French, German, Latin, or in one of the Scandinavian languages.

At the solemn reunion which takes place on the anniversary of the death of the donor, December 10, the corporations will make known publicly their decision and bestow upon the laureate a check for the value of the prize, a diploma, and a gold medal bearing the effigy of the donor with an appropriate legend. The laurete is obliged, unless prevented by unforeseen circumstances, to give during the six months following each reunion a public lecture on the subject of the work crowned. This lecture will be given in Stockholm, or for the peace prize in Christiania. Decisions in regard to the prizes are without appeal. There are many other provisions, which are fully set forth in the rules and regulations as published in the SUPPLEMENT. The prizes which will be distributed in 1901 will amount in all to $402,000, or $80,400 for each division.

HIGH POWER ENGINES AND THREE-PHASE GENERATORS AT PARIS.

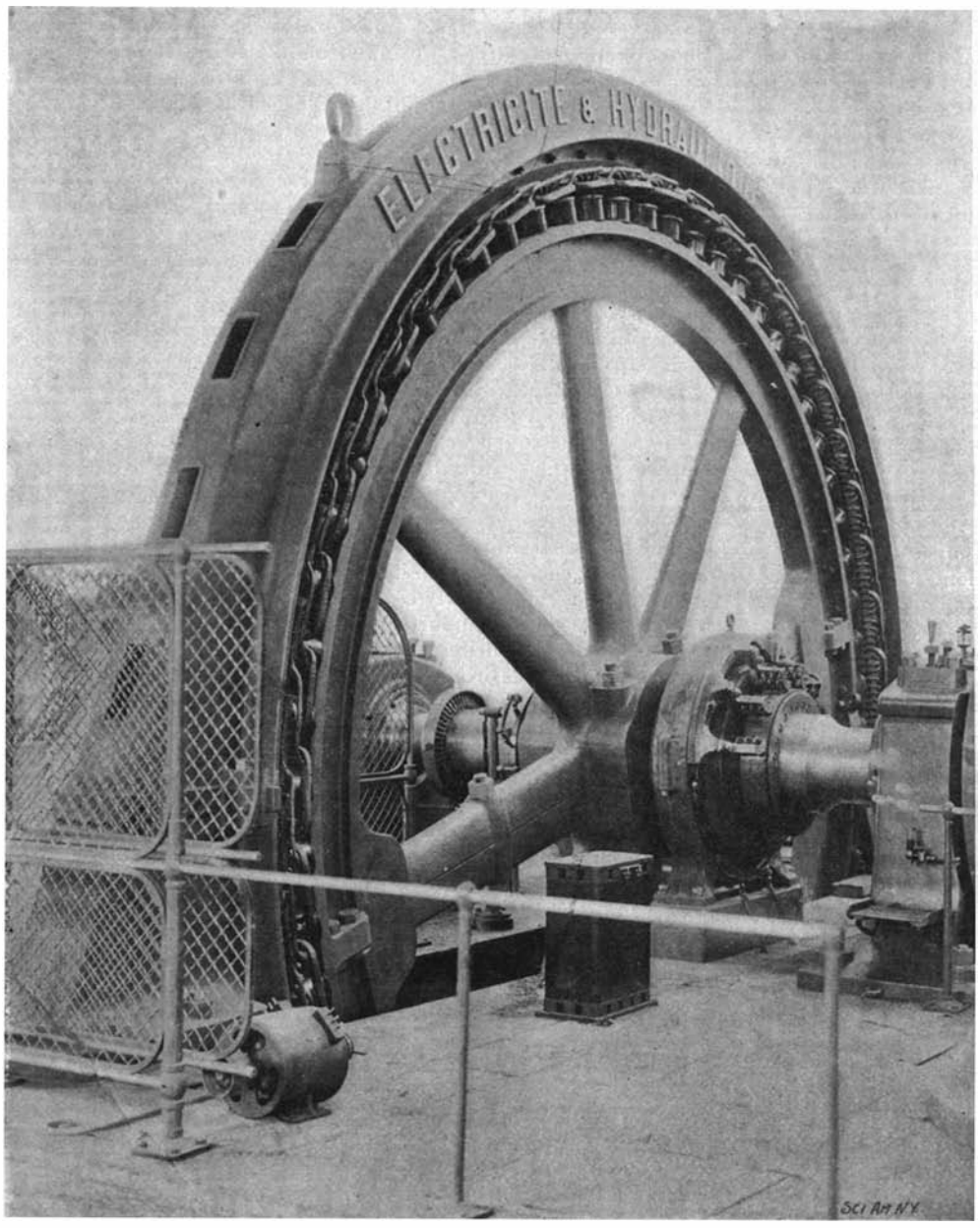
BY FRANK C. PERKINS.

Some of the most interesting as well as important exhibits at the Paris Exposition this year are the large direct-connected Drehstrom alternating current generators and high power triple expansion engines, the largest of which are of European make.

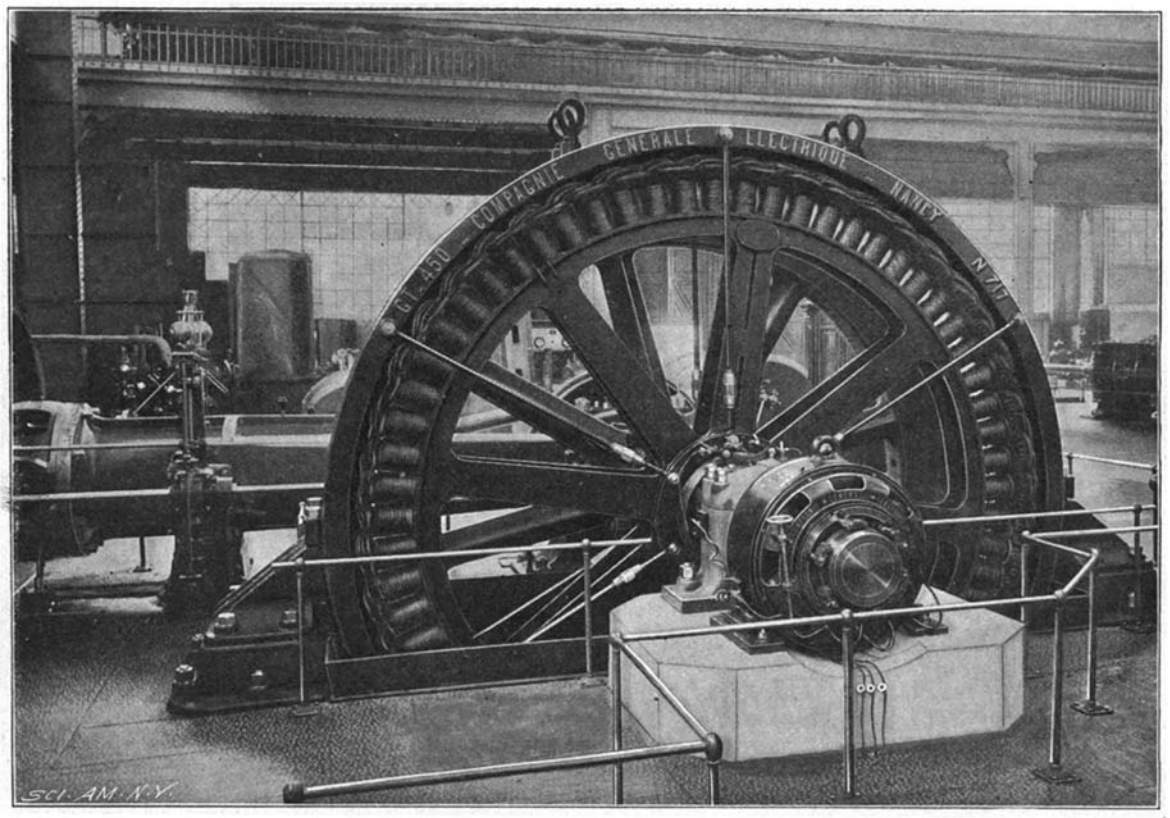
A three-phase alternator which is of considerable interest is the one built and installed at the Exposition by the French firm the Compagnie Générale Electrique of Nancy, shown in the smaller engraving. This is of the type of alternators having revolving field magnets and stationary armatures. This fly-wheel field magnet has a speed of 93·5 revolutions per minute and has a frequency of current in the armature of fifty periods per second. In each phase it generates a current of 87 amperes at a potential of 3,000 volts. In order to secure mechanical rigidity in the armature, it will be noted that on each side there are six rods of forged iron terminating at a collar piece, each of which can be adjusted by set screws. This stationary armature has the appearance of great lightness. This firm in their construction greatly decrease the gross weight of cast iron parts relatively to the active weight of the plates of the armature.

The direct current dynamo used to excite the fields of this alternator is seen in the foreground in the small engraving, and it will be noted is directly connected to the driving shaft of the main machine. The collector brushes of this machine are seen on the end of the shaft, the commutator being placed on the extreme outside, while the slip rings and brushes of the alternator are inside the main bearing.

The three-phase alternator shown in the larger engraving is directly connected to a 1,000 horse power horizontal compound engine manufactured by Weyher & Richemond, of Paris. This engine is on exhibition in the French section, and is capable of delivering a current of 250 amperes at a potential of 2,200 volts. The speed of the revolving field magnet is 95 revolutions per minute, and the frequency at this speed is 50 periods per second. The field magnets consist of 64 pole pieces, which are excited as described in the other case.



THREE-PHASE ALTERNATOR, WITH 1,000 HORSE POWER ENGINE.



THREE-PHASE ALTERNATOR AT PARIS EXPOSITION.

Application of Aniline Dyestuffs to Leather.

Mr. M. Chas. Lamb, head of the Leather Dyeing and Finishing Department, Herold's Institute, Bermondsey, read a paper on the dyeing of leather early this year before the West Riding Section of the Society of Dyers and Colorists, and reprinted in the journal of the society. The author writes:

"The dyeing of leather, I may say without fear of contradiction, is the most difficult branch of the art of dyeing. The difficulties encountered by the leather dyer are numerous; one of the many is that skins which have been tanned with different tanning materials take the dye very differently. This is due to the fact that the vegetable material, with which the skins have been tanned, itself contains coloring matter which is imparted to the leather. Another of the dyer's difficulties comes of the very marked and characteristic differences in the fibrous structure of the skins derived from different sources, some skins being open and loose in texture, and others firmer and more compact, which affects the dyeing, in that an open, coarse-textured skin will absorb more dye than will a skin of firmer texture, the resulting shade being much deeper in the former case than in the latter. Skins of the same class, moreover, exhibit in a more or less degree this difference in texture, and it is a fact well known to leather dyers that in a number of skins which have been dyed in the same bath, there are always one or two which are not exactly the same shade as the rest. I have been consulted from time to time by leather manufacturers, who have found difficulty in dyeing level, that is, obtaining in one and the same skin the same shade throughout. This is usually due, not to the dyestuff used, or the method of dyeing, but to the preparatory treatment being insufficient."

Mr. Lamb gives an account of the operations preliminary to the actual dyeing, and then proceeds to describe the three distinct methods of dyeing in use in this country, viz. the "tray," the "paddle," and the "drum" methods. He specially alludes to bookbinding and furniture leathers, and refers to the movement among bookbinders and others interested in the preservation of books for the investigation of the causes of decay, which has caused the appointment by the Council of the Society of Arts of a committee to consider the whole question of leather for bookbinding. Mr. Lamb writes:

"During the past few months there has been considerable controversy among the principal bookbinders in London with regard to leather used in bookbinding, so perhaps it may not be out of place for me to say a few words on the matter. Bookbinders contend that the leather used in bookbinding perishes in the course of a comparatively short period. The chief cause of these leathers rotting in a comparatively short time is undoubtedly the reckless use of sulphuric acid in clearing and dyeing, and insufficient precautions being taken to remove the acid, or to neutralize it, after dyeing. If the least trace of acid is left in the leather, it becomes concentrated in the fiber when the leather is thoroughly dry, and completely destroys the leather. I have here a few specimens of leather that were dyed with acid colors about two years ago; these, as you will see, though the leather was well washed after dyeing, are completely rotten, the fiber being entirely destroyed. I have found that it is practically impossible to remove sulphuric acid from leather by washing in water, as samples of leather which were dyed with the acid colors, and the addition of the requisite amount of sulphuric acid, on analysis still showed traces of the vitriol, after they had been left in a running stream of water for a period of five weeks. I think that another matter which has been to some extent overlooked by those authorities who have been consulted on the matter by the bookbinders is the use of soda for stripping the natural tannage of many of the foreign tanned leathers, as I mentioned earlier in this lecture; this, in my opinion, causes the leather to be unreliable, though undoubtedly sulphuric acid is the chief cause of the mischief. In my opinion, bookbinding leathers and leathers for furniture purposes should not be dyed with the acid colors together with the addition of sulphuric acid. If the acid colors are used, they should be used either without any addition, or, if any, only the addition of acetic acid, or a little bisulphate of soda, which latter agent, so far as I have been able to test, has apparently no injurious effect upon the leather, if not used in great excess. The leather should on no account be stripped of the tanning with an alkali, nor should it be cleared with vitriol or any other acid that has an injurious effect upon leather; practically the only one permissible being acetic acid. It would be much better to use the basic dyes, where no acid is required, when dyeing these leathers, though unfortunately this class of coloring matter has the reputation of not being so fast to light as the acid dyes."

A PETROLEUM spray is used on the Missouri Pacific line for lighting the fires of locomotives. The reservoir for the oil is mounted on wheels. Compressed air is used to spray the oil. The air can be taken from any Westinghouse receiver or pump. In using the apparatus, the bed of coal is first placed on the grate, and then the jet spray is ignited and directed on to the coal, being moved over the surface until the whole is ignited, which usually requires about fifteen minutes.

THE PRACTICAL APPLICATION OF THE HYDROSTATIC LEVEL IN BUILDING CONSTRUCTION.

BY OWEN B. MAGINNIS.

The science of modern building construction necessitates the introduction of such instruments, tools, and appliances as will expedite the work and lessen expense by economizing time. Such an implement is the hydrostatic or water level, shown in the accompanying drawing. The instruments most popular for leveling in laying out large works are the engineer's transit, theodolite or architect's Y level, all of which are of the utmost utility for mechanical operations. However, the form of improvised water level shown in our engraving is, perhaps, most adaptable, as it can be easily and cheaply made, is accurate in its action and simple in its application. As will be seen, it consists of a long piece of ribbed rubber hose or pipe, half an inch internal diameter, with pieces of transparent glass tubing, twelve or eighteen inches long, inserted in each end. These glass tubes should, if obtainable, be graduated into inches and parts of inches down to sixteenths, but if graduated tubes are not to be had, smooth tubes of clear thick glass of chemical tubing will do, and a quarter or half-inch section can be cut off the end of the rubber pipe and set over the glass tubes, which will slide up or down so as to form a gage.

Water is poured into the rubber hose pipe and glass tubes till the ends overflow, when they are kept full by placing a small tip or faucet at the ends of the tubes, as shown. When in use, the faucets must be opened in order to allow the water to find its own level. One glass tube is placed against the wall which has been built to the required height, being held firmly against the face of the wall with the gage set four, six or eight inches from the top as desired, the gage being kept at the edge of the brick or stone wall templet, from which the required level is to be measured. Here it is held by one man, while another carries the other glass tube to the object to be measured. When the water is exactly on the line of the gage, the level point is determined, and the distance of the detail above or below the gage will denote the discrepancy in the relative heights. This will be readily understood from the engraving, where this simple instrument is represented in use as setting the levels on top of a foundation wall for templets for iron beams, or in a position where the transit or Y level and staff would not be so convenient or so applicable. Many masons use this instrument with a rod for finding depths of trenches for walls, piers, etc., for leveling for templets, sills, water tables, or other details, especially in an excavation which is crowded with piers, shores, derricks or appliances, which, of course, render the use of the transit or Y level impossible.

A SIMPLE HYDROSTATIC LEVEL.

THE FRENCH METEOROLOGICAL OBSERVATORY AT TRAPPES.

It is, perhaps, not generally known that Major Baden-Powell, who has distinguished himself more than once in the Transvaal war, is not only a soldier of unquestionable ability but a scientist whose meteorological investigations have been stamped with the official approval of England's war ministry. It was through his influence that the English army abandoned the cumbrous military balloon and adopted in its stead the more easily controlled and more simply constructed kite.

The experiments made by the English major in collaboration with his brother officers have been described in Pearson's Magazine. As a result of the experiments in question, it was asserted that a man could be lifted several hundred feet in the air without the slightest danger and without the aid of any gas receptacle. An apparatus strong enough to lift two men weighs hardly more than 100 pounds. Kites can be assembled and sent into the air in five minutes. Their descent can be regulated by a parachute. The cost is hardly a fiftieth part of that of a balloon ascension.

Baden-Powell began his experiments in 1893. If he has not magnified the importance of the results which he has obtained, it is not too much to hope that, before the Transvaal war has seen its close, the utility of the kite as an instrument in modern warfare will be assured. If the truth must be told, it is difficult to imagine a man suspended 2,000 feet above the ground from a machine which is the plaything of the winds and which is only too ready to plunge down at any moment. But it is still more difficult to imagine this same man, without that feeling of security so essential to accurate observation, spying upon an enemy and endeavoring to gather such information as may be of value.

The proper sphere of the kite's usefulness would seem to be in that field of meteorological experiment in which Franklin was a pioneer. That the kite can also be used for military purposes (signaling and the like), and especially for taking bird's eye photographs by means of automatic apparatus, seems likely enough. But the lifting of a man to the dizzy height of a thousand feet or more, so that he may leisurely study an enemy's position, transcends the bounds of possibility.

In France both the kite and the balloon are also used; but not so much for military observation as for scientific study. At Trappes, between Versailles and Rambouillet, not far from the famous ruins of Port Royal des Champs, a camp and an observatory have been established where a few earnest scientists are devoting their time to the study of the upper strata of the atmosphere. This meteorological station owes its existence to the untiring energy of M. Léon T. de Bort, who has sacrificed not only his time but also his fortune to furthering the science of meteorology.

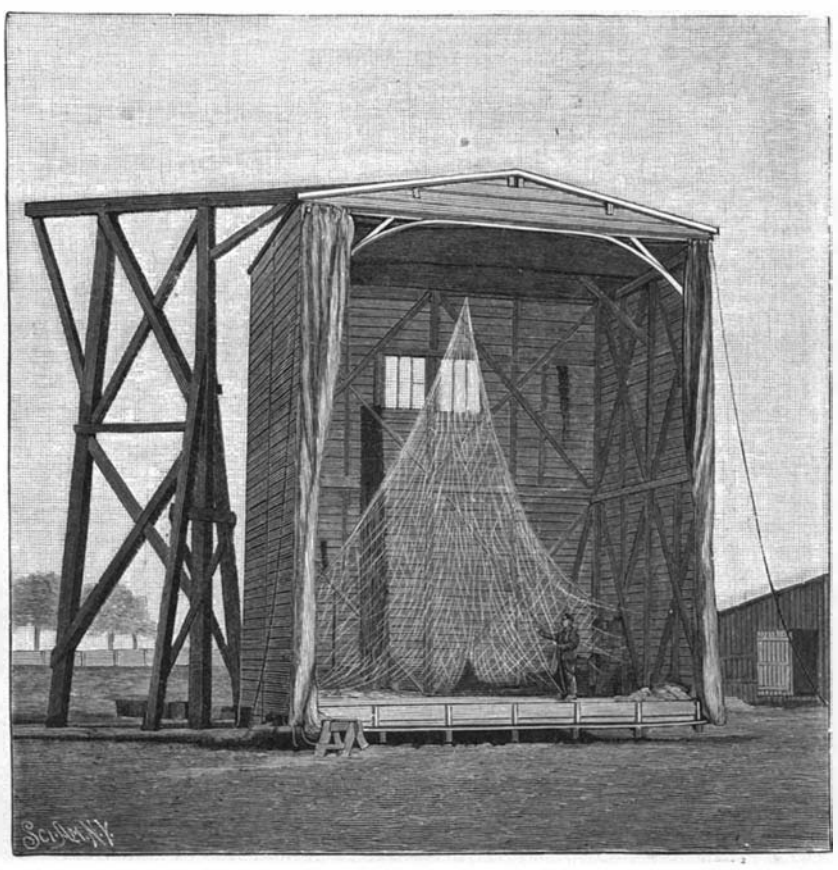
Perhaps the most curious structure among the isolated buildings which comprise the station at Trappes is the rotating house in which balloons are inflated. The house is mounted upon rollers so that it can be turned to suit the direction of the wind, and is connected by underground pipes with the hydrogen plant which forms an annex to the balloon and kite shed. In one of the adjacent buildings such instruments of precision as thermometers, barometers and the like are kept. The remaining houses serve either as photographic dark rooms and camera obscuras for photographing clouds, or as working rooms in which mathematical computations are made.

The experiments at Trappes are conducted with pilot-balloons and kites. The pilot-balloon is free. Once inflated and left to itself, it rises and drifts away to fall whenever its gas has escaped. If it lands in a country in which the people are enlightened and civilized, it is sent back to the starting place, together with all the automatic recording apparatus with which it was equipped.

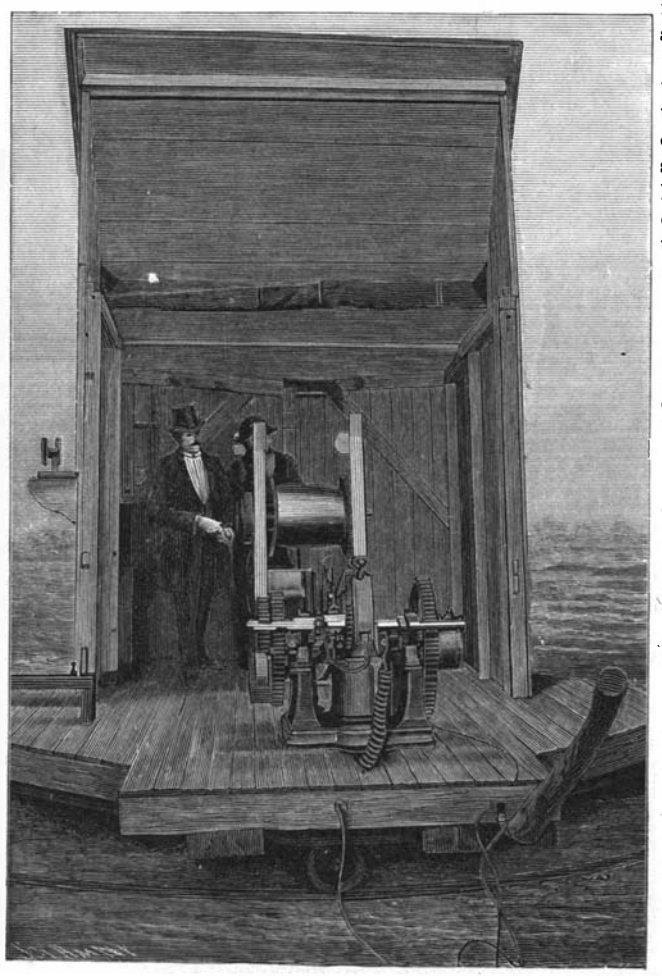
The recording apparatus referred to comprises several small aluminium cages. Upon a cylinder rotated by clockwork, three pens register the thermometric, barometric, and hygrometric conditions. As a matter of precaution, each instrument is accompanied by a checking apparatus, with the records of which the indications of the first instrument must agree.

Although the Trappes Observatory for dynamic meteorology has been in existence but two years, as many as 174 pilot-balloons have been sent up from its grounds. These balloons have attained an average height of 6,000 meters (19,680 feet), and almost all have fallen in the east, whatever the distance they covered. One balloon fell in the very heart of the city of Berlin. That the prevailing winds in the upper strata of the atmosphere are therefore southwest or southeast is obvious.

In addition to pilot-balloons, Hargrave box-kites are used, varying in height from 6 to 8 feet. They are secured to a windlass upon which 10,000 meters (32,800 feet) of steel wire are wound. The windlass is driven by an electric motor. At the ground end of the wire an instrument is mounted which indicates the length of wire paid out and the angle of its inclination. Within the box-kites other instruments are placed which record the temperature, pressure of the atmosphere, and hygrometric condition of the strata which have been traversed.



BALLOON-INFLATING HOUSE.



KITE-LINE-WINDING APPARATUS.

THE Department of Works of New South Wales is about to introduce a large floating crane for use at the port of Sydney. The crane, which is to be constructed within the colony, is to have a lifting capacity of 80 tons at a speed of 5 feet per minute, and 20 tons at a speed of 14 feet per minute. It is estimated that it will cost about one hundred thousand dollars.

Automobile News.

A new apartment house in course of erection on West End Avenue and Seventy-ninth Street, New York, will have attached to it automobile stables for housing the automobiles of tenants. Facilities for charging the electric vehicles are provided on the first floor, and the second floor is intended for living apartments for the vehicle attendants.

The new system of electrically propelled vehicles known as the Lombard-Gerin automotor has recently been put in operation at Vincennes Park. In this system the car, a kind of omnibus, is driven by a motor attached to one of the axles; it takes its current from an overhead wire, which supports a rolling trolley carriage from which hangs a flexible cable connected with the vehicle. At Vincennes a series of posts have been erected along the road which passes around Lake Daumesnil. As there are, of course, no rails, two bare copper wires are strung upon the posts; upon this rolls the carriage, carrying the flexible cable. The cable passes into a hollow mast supported on the top of the vehicle; its length may be increased or diminished, the slack being partly taken up by a counterweight contained in the column. The trolley is itself provided with an electric motor, which operates two friction rollers driving the main pulleys, which travel over the wire. The motor of the vehicle is of the continuous current type with series winding. On the opposite end of the shaft it carries a collector formed of three rings, by which alternating current, three-phase, is taken when the motor is in operation. This current is used to drive the motor of the trolley, and to this end the cable uniting the latter to the vehicle has six wires, two of these being direct current at 500 volts to the motor of the vehicle; this current then returns to the trolley in the form of three-phase current by three wires of the cable. The sixth wire is used to control a brake on the motor of the trolley. This system has been previously tried over a stretch of road five miles in length along the quay of Issy-les-Moulineaux, outside of Paris, where it succeeded very well. The tests made at Vincennes have met with equal success, and show to the public the method of working and the advantages of the system.

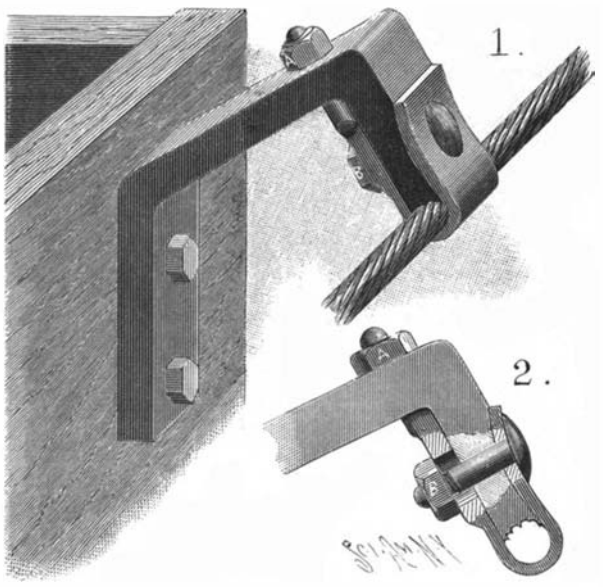
One of the most interesting features in the recent series of military maneuvers carried out in France has been the use of automobiles for transporting the officers and for carrying searchlights. The officers are now commencing to use the automobile, and find it a great convenience. General Brugère, for instance, has professed quite a liking for the automobile; during the maneuvers he made a trip from Chartres to Rambouillet, in order to pay his respects to President Loubet. Mounted on a 16 horse power machine, he made a speed of 36 miles an hour, the train making only 30 miles; he now prefers the automobile to the horse. General Lucas also favors the automobile, but prefers to travel at somewhat safer speeds. The officers had prepared a surprise on the occasion of the maneuvers, in the shape of an automobile searchlight. This was kept secret until the last moment, having been constructed under the supervision of General Brugère. M. Marcel Renault is the inventor of the system. The automobile used is of the road-wagon type, having two seats in front. In the rear has been constructed a light column which supports the searchlight at the top, carrying an arc lamp entirely inclosed in a metallic case which takes about 7 horse power. Below is a small dynamo of 7 horse power; it is mounted on a secondary shaft, which may be connected with the main shaft of the motor by a transmission system capable of being disconnected at will. The machine started out after dark on the immense plain of Beauce, which extends around Chartres, making a certain distance lighted only by its acetylene headlight, which covers about 150 feet. At intervals the machine stopped, and by means of a lever the dynamo was set in motion; the searchlight then sent a stream of light covering a distance of two miles, and by its means the country around was explored. After proceeding a certain distance this maneuver was repeated, and it was seen what valuable services an apparatus of this kind would render in such cases. The military staff were greatly satisfied with its performance, and there is no doubt that this automobile searchlight will prove a valuable adjunct to the army. For illustrations see the current SUPPLEMENT. On one occasion, a member of General Brugère's staff traveled over 100 miles in an automobile in a very few hours, and was able to supply the commander-in-chief of the army with full details of the operations accomplished by the various detachments. The Scotte train appears to have distinguished itself also in these maneuvers. One morning this train left Paris at six o'clock in the morning with a load of 30,000 pounds of corn for the front, and returned the same night, having accomplished a total distance of 50 miles. To perform the same task with animal labor it was estimated that thirty-six horses would have been required, and that they would have occupied three days to cover the same distance with the same convoy, which would have been twice as long and would have required a larger escort.

A CABLE-GRIP FOR MINING-CARS.

The accompanying illustrations represent an improved cable grip invented by Mr. George C. Niles, of Arcata, Cal., for use on mining-cars and other vehicles to be propelled by a traveling cable. Fig. 1 represents the device in perspective; Fig. 2 in partial section.

The grip comprises a fixed jaw secured to a bracket and a U-shaped clamping-band between the unequal members of which the jaw projects. The lower middle portion of the band clamps the cable against the free end of the fixed jaw. The band is clamped to opposite sides of the fixed jaw by means of a bolt and nut, *B*, the bolt passing through a slot in the longer member of the band. The end of the longer member of the band is screw-threaded, passes through a slot in the bracket of the fixed jaw, and is held in place by a nut, *A*.

When the nut, *B*, is released and the nut, *A*, screwed



AN IMPROVED CABLE-GRIP.

up, the clamping-band forces the cable up against the free end of the fixed jaw. This adjustment having been made, the nut, *B*, is screwed up so as to hold the members of the clamping-band firmly in position on opposite sides of the fixed jaw. The short member of the clamping-band is bent to fit the correspondingly-shaped outer face of the fixed jaw, so that the lower curved portion of the clamping-band properly fits the cable after having been adjusted.

A CONVENIENT ENVELOP MOISTENER AND SEALER.

An invention which has recently been patented by Charles L. Vose, of Westerly, R. I., provides a simple device for moistening and sealing envelops in a manner which is certainly far more cleanly than the method with which we are all familiar.

The moistener and sealer consists essentially of a central glass tube provided at one end with a soft rubber nipple in which a sponge is received, and at the

VOSE'S ENVELOP MOISTENER AND SEALER.

other end with a hard rubber cap in which the metal bearings of a soft rubber roller are held. The central glass tube contains water which is fed to the sponge. In sealing an envelop, the gummed flap is moistened by means of the sponge. The device is then turned around, and the moistened flap evenly and squarely sealed by means of the rolls journaled in the cap previously mentioned.

For the purpose of holding the moistener and sealer when not in use, Mr. Vose employs a holder composed of a soft rubber suction base upon which a glass holder is mounted. When the rubber suction base is moistened and pressed down on a table or desk so that the air is expelled, the holder will be so firmly affixed that its removal requires no little effort.

A CORRESPONDENT in Providence, R. I., suggests that wireless or aerial telegraphy be called "airograph."

Science Notes.

The tomb of Sir Humphry Davy, at Geneva, which has been in a neglected state for some time, has recently been restored.

Astronomer Wolff, of Heidelberg, has, by means of his photographic process, discovered three asteroids in a single night.

Nearly every window in Paris, specially in the poorer quarters, has plants growing in pots. A wealthy philanthropist has had the idea of opening a hospital for sick plants in the Faubourg St. Antoine. Greenhouses have been built and there are gardeners to look after plants that are brought in until they recover. They are then returned to their owners.

A basket modeler has been invented by Mr. Thomas Taylor, the superintendent of the Liverpool School for Indigent Blind, for the purpose of assisting blind people in the construction of their baskets. The device consists of a wooden base-board drilled with holes into which are fitted steel pins arranged to the required shape. The wicker is then worked over these pins with the utmost ease and rapidity.

The Prussian government is making systematic inquiries with a view to increasing knowledge upon the subject of cancer. Every registered physician has received a paper asking questions relative to experience in cancer cases. An attempt is being made to find out if cancer is hereditary, if it is contagious, and whether it is connected with any particular habit, such as over-indulgence in alcohol, tobacco, etc., and whether it is more prevalent in one district than in another.

Widespread damage has been caused in the Archæological Museum in Florence through the madness of a door-keeper. He at first endeavored to murder the director of the museum, but as his efforts in this direction were frustrated, he seized a chair and commenced to smash everything that came within his reach. Before he was overpowered he had hopelessly pounded to fragments an ancient historic vase discovered in China in 1844 and estimated to be worth $100,000, and also a Roman chariot found in Egypt which was worth over $600,000 and which we have illustrated.

A short time ago, during some digging operations in Chester, England, an interesting relic of the Roman occupation of Great Britain was unearthed. This was a section of lead piping, supposed to have been laid about the year 79 A. D., and was utilized for the purpose of carrying water to the Roman camp. About twelve months ago a similar piece of piping was unearthed near this same spot, but its origin was disputed. This new discovery, however, sets all such controveries at rest, since upon the piping are plainly inscribed the words "Cnœus Julius Agricola." This relic is additionally interesting since it is said to be the only inscription extant bearing the Roman governor's name.

One effect of the cotton crisis in Liverpool, Manchester, and the other towns of Lancashire, owing to the failure in American cotton, has been the introduction of Egyptian cotton upon the English market. Efforts have been made for some time past to induce the spinners of Lancashire to experiment with the Egyptian product, but with only indifferent success, since the supply from America was so adequate. But America's shortage has proved Egypt's opportunity, and now several spinners are using Egyptian raw material. If the latter article obtains a strong footing among the Lancashire spinners, it will possibly be a heavy blow for the American growers, since the Egyptian producers will exert themselves to the utmost to flood the market. If they can only succeed in meeting the demand, they will be sure of an increasing and lucrative trade.

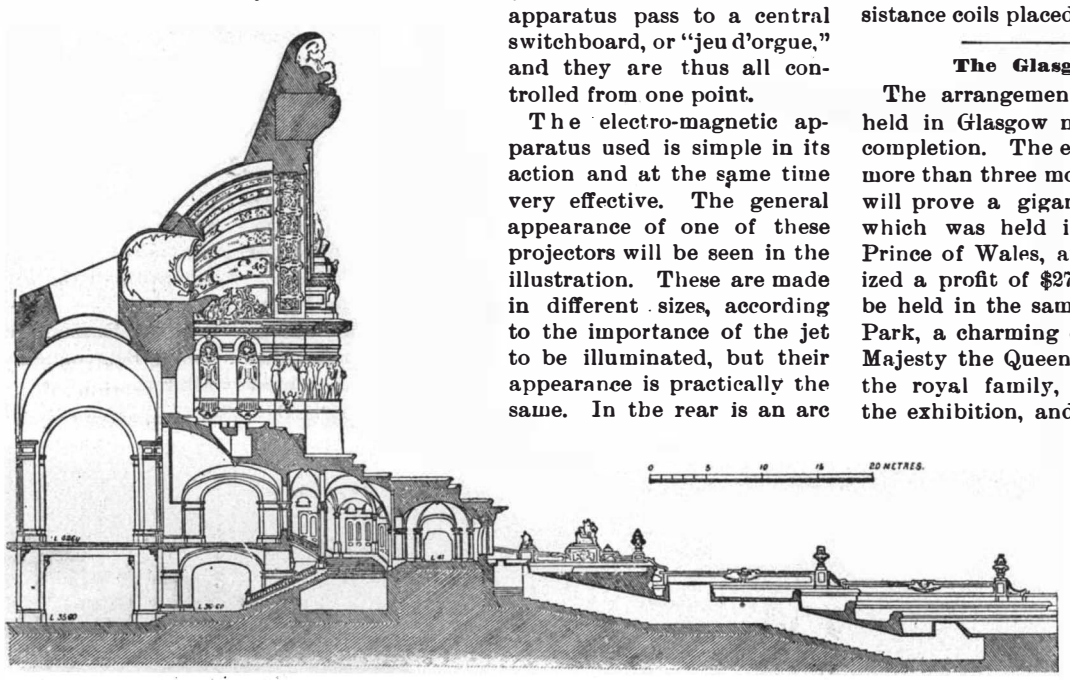
M. Schoen has devised a new photographic printing process. The inventor bases his discovery upon the use of diazo compounds, as in the primulin process and feer-type. He converts ortho-amido-salicylic acid into its diazo compound by the action of sodium nitrite on a well cooled solution of the acid in dilute hydrochloric acid. The precipitated product which results is washed with small quantities of water, and is subsequently dissolved in a dilute sodium carbonate solution. The paper to be coated is either immersed in this solution, or the latter may be applied to the paper with a brush; or with a mixture of it and gelatine, and then dried in the dark room. The paper is then placed in the printing frame under the negative, and printed in the ordinary way until a strong red image is obtained. The fixing and toning of the prints are exceedingly simple, since the print has only to be washed in water, as is the case with ferro-prussiate paper, until the yellow color of the unexposed parts of the paper has disappeared, when the finished picture in red is obtained. This red substance is the resultant effect caused by the light acting upon the diazo compound. The color does not change at all through exposure to the light, but a variety of tones may be obtained by immersing the finished picture in solutions of salts of iron, cobalt, etc., or in lime or baryta water.

ELECTRICAL PALACE AND FOUNTAIN AT THE PARIS EXPOSITION.

The Electrical Palace and Fountain occupy one end of the Champ de Mars and constitute the central feature of this part of the Exposition grounds. By day, the ensemble presents a highly decorative effect, but it is at night that it appears to best advantage, when the crest of the Electrical Palace is outlined by thousands of incandescent lamps of varying colors, and the various cascades and jets of the fountain are brilliantly illuminated.

One of the great difficulties which confronted the projectors of the Exposition was to mask the great Machinery Hall of the Exposition of 1889. It was decided not to remove it, but to conceal it in such a way as to make it harmonize with the surrounding buildings. This was done by covering the entire front by a Château d'Eau or large fountain. It consists of a lofty hemispherical structure, the concave side facing on the gardens, forming at the same time the chief architectural and central feature of the Palace of Electricity and the apparent source of the cascade. The façade of the Electrical Palace is surmounted by an ornamental crest formed of repoussé metal work arranged in various designs; some of these are formed by the addition of stained glass. The general tone of the metal work is buff and white, which harmonizes well with the façade of the electric fountain, which is of cream white staff. At the top of the crest is a series of white globes containing incandescent lamps of different colors, below is a similar series of globes, and the form of the crest is outlined by incandescent lamps which are distributed over it. The whole may be illuminated in red, yellow, blue or white, by a suitable arrangement of circuits, or different combinations of color may be secured. A number of arc projectors placed in the rear illuminate the stained glass designs with striking effect. At the highest point is a group representing the Genius of Electricity drawn in a car by hippogriffs; in the rear of the group is an immense star formed of a gilded metal frame carrying glass brilliants strung upon wires.

The central niche of the façade is surmounted by an arch in handsome relief designs. The central niche extends back to a considerable depth; it is also very handsomely ornamented by appropriate relief designs and groups. In the center is the grotto from which proceeds the main cascade. Below the grotto are a series of basins descending in a succession of different levels and finally reaching the main basin. The water is elevated to the height of the grotto, from which it falls, forming the principal cascade, into the succession of basins below. One of the basins of the descending series has been made somewhat larger than the others, and is provided with a series of parabolic jets which are directed toward the front.



THE PARIS EXPOSITION—SECTION OF THE ELECTRICITY BUILDING AND CHATEAU D'EAU.

In order to produce an effective illumination of the cascades it has been found necessary to divide these into drops, as a sheet of water illuminated by lamps placed in the rear would not appear luminous in itself, while the drops reflect the light, and the cascade thus appears illuminated. The borders of the basins are provided with an arrangement to separate the water into drops, consisting of an iron support or comb which holds a succession of glass strips. The water which falls from the upper basin, forming the main cascade, as well as the cascades of the succession of basins below, are all divided in this way into separate sprays. These are illuminated by a series of incandescent lamps which are placed underneath the borders of the basins and back of the cascades. A series of corrugated reflectors placed back of the lamps direct the light upon the sprays. For the illumination four colors are used—red, yellow, blue, and white; the lamps of different colors are arranged alternately, and for each color there is a separate circuit which passes to a mechanism in the basement, which allows each color to be thrown on at will. An arrangement is also provided by which it is possible to pass gradually from one color to another, these being mingled and giving a series of intermediate tints. In the grotto is a large spray which is formed by three circular pipes, one above the other, pierced with holes. Upon the pipes are mounted incandescent lamps with reflectors to direct the light into the spray, which is thus brilliantly illuminated. These pipes are arranged upon a hinge which allows the two upper pipes to be lowered when the spray is not in action, rendering them invisible from the front.

In the main basin are a number of vertical jets, arranged in groups on each side. The main basin has a well-laid cement floor, along which proceed the two main supply pipes which branch from the center toward the front; from the main pipes are branches formed of lead pipe which supply the jets. The four fountains in the rear on each side have a central jet with three others grouped around it; the large fountains in front have each eleven jets.

The illumination of the parabolic and vertical jets of the fountain is carried out by means of arc lamps and reflecting mirrors, placed in the basement underneath the fountain, the light being projected up either vertically or at an angle according to the character of the jet. The parabolic jets are illuminated at their commencement and also where they fall into the basin by two separate windows, each with its own apparatus, these being arranged to always give the corresponding colors.

Underneath the fountain is a very extensive basement, where all the arrangements are provided for the water supply and the lighting. The basement has been constructed with cement walls and floors; the ceiling is braced at intervals by pillars. In the rear, below the central niche, are the two main pumps for the water supply. These are driven by electric motors, and the volume of water furnished to the fountains is over 350 gallons per second. The water passes from the pumps to two large pipes, about two feet in diameter, which proceed toward the front, where the branch pipes lead to the different parts of the fountain. The main point of interest in the basement is the installation of reflecting apparatus with arc projectors for illuminating the jets and giving the different colors. The light is sent up through heavy glass panes, laid in the cement floor of the basins; the mechanism of the different color screens has been arranged so as to be entirely automatic, and is operated by an electro-magnetic system. The wires of all the apparatus pass to a central switchboard, or "jeu d'orgue," and they are thus all controlled from one point.

The electro-magnetic apparatus used is simple in its action and at the same time very effective. The general appearance of one of these projectors will be seen in the illustration. These are made in different sizes, according to the importance of the jet to be illuminated, but their appearance is practically the same. In the rear is an arc lamp with its parabolic reflector, and in front of this is a series of color screens. These are formed of a brass framework holding the panes of glass, leaded together, this arrangement being used to avoid cracking by the heat of the arc. Each frame is made in two halves, which are hinged together so that when the upper half closes it draws the lower half with it. There are thus three sets of shutters, one for each color, red, yellow, and blue. The closing of the shutters is carried out automatically by the magnetic arrangement seen to the right and left. One of the frames carries a projecting arm, to which is fixed a core of soft iron; this passes into one of the solenoids at the side. When the current is sent into one of the solenoids, the core is drawn in and the two halves of the shutter are brought together. When the current is cut off, the shutters fall apart by their own weight. Each of the solenoids thus operates a different color, their circuits being quite independent. When all the shutters are closed, the light is practically cut off, and when all are open the fountains are illuminated in white. For the illumination of the parabolic jets, one apparatus is placed under the orifice of the pipe and somewhat in the rear, as shown in the diagram, and thus illuminates the beginning of the jet. In front are placed a number of windows at the point where the spray falls, and each window has a separate apparatus. The vertical jets are lighted by mirrors placed in front of the projectors at an angle of 45°, sending the light up vertically through the windows.

The circuits of all the solenoids are brought to the central "jeu d'orgue," a view of which will be seen in the illustration; the sectional view shows its general method of operation. Above are a number of horizontal levers which pass to the rear, where they carry two pins which fall into mercury cups, thus making contact. They are drawn down by a rod attached to each, which passes below and is fixed to the rear of a lever. The front of this lever projects forward and resembles a piano key in appearance; there is thus a succession of these keys, each of which closes a different circuit. Below the keys revolves a cylinder of metal around which are fixed a number of screws, whose heads form projecting points. These strike the keys and cause the levers to be operated in succession according to a given arrangement. In this manner the solenoids of all the apparatus are operated at once, and all the jets are illuminated at once with a predetermined arrangement of color. The cylinders are turned by a hand-wheel and gearing in the center, and the different changes of color may be made in more or less rapid succession. Below the keyboard is a set of levers by which all the solenoids of each color may be operated independently of the keyboard; thus one lever throws on all the reds, etc. A third lever works all the solenoids at once, thus giving either extinction, with all the shutters down, or the white light of the arc, when all are raised. The fourth lever is used to lift all the keys to allow the cylinders to be changed. A number of these cylinders have been provided, each giving a different play of color.

The circuits of the incandescent lamps for the illumination of the cascades and the other parts of the fountain, as well as those upon the crest of the Palais d'Electricité in the rear, pass to a similar "jeu d'orgue," provided with cylinders giving a certain arrangement of color. The incandescent circuit has, besides, an apparatus which permits a gradual lowering of brilliancy and a gradual passage from one color to another. This consists of a flat metal table upon which are arranged a number of contact-bars, across which are moved three sets of contact-brushes by means of an appropriate mechanism operated by a motor. To the contact-bars are connected the terminals of a series of resistance coils placed below.

The Glasgow Exhibition of 1901.

The arrangements for the great exhibition to be held in Glasgow next year are rapidly approaching completion. The entries for the exhibits were closed more than three months ago. It is anticipated that it will prove a gigantic success. The last exhibition, which was held in 1888, and was opened by the Prince of Wales, attracted 6,000,000 visitors and realized a profit of $270,000. The present exhibition will be held in the same place as the last, Kelvin Grove Park, a charming expanse of sixty-seven acres. Her Majesty the Queen, and the other chief personages of the royal family, have extended their patronage to the exhibition, and it has also received the support of the élite of English society, and of the principal scientists of the country. The scope of the exhibition is to present a full illustration of the produce and manufactures of the British Empire, its dependencies, dominions and colonies, together with an adequate representation of other countries. Naturally, since Glasgow is the focus of the shipbuilding, engineering, and manufacturing industries of Scotland, the collection and exhibition of machinery will be exceptionally prominent. For the accommodation of this section a tremendous building has been erected.

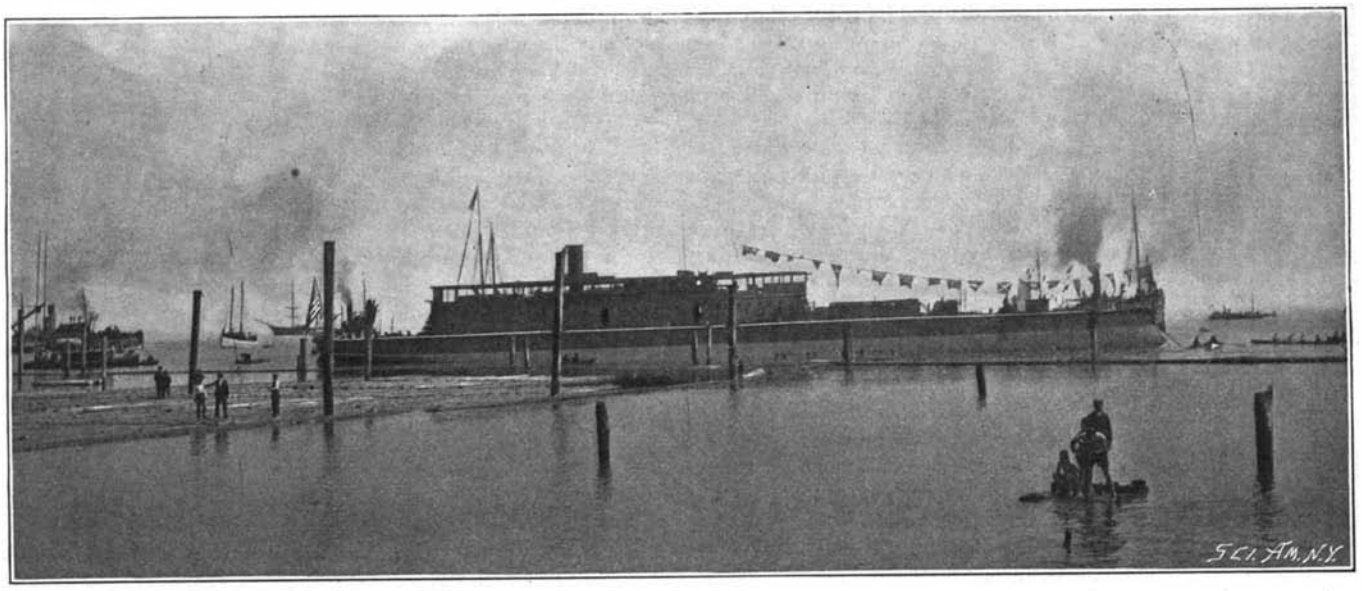
Probably the most striking buildings, however, are the new art gallery and museum, in which are to be placed the art and science collections of the Corporation of Glasgow. This building was really intended as a memorial of the 1888 exhibition, and, indeed, the profit derived from that show constituted the nucleus of the vast sum that has since been collected to defray the expense of its erection. The buildings have cost $1,000,000 to construct, of which sum $650,000 has already been subscribed, and it is anticipated that the profit to be derived from this exhibition will be sufficient to reduce the balance of the cost. The executive council have arranged to form a loan collection of pictures and sculpture to illustrate the progress of art during the nineteenth century. The Queen of England has promised to send appropriate specimens from the royal collections, while the Prince of Wales has also consented to loan several artistic treasures.

The river Kelvin, which meanders through the grounds in which the exhibition will be held, will be utilized for the purpose of exhibiting naval shipbuilding and life-saving apparatus, water carnivals, and so forth. Lectures of scientific and topical interest will be delivered by various authorities, while recreations of every description and musical entertainments will also be provided. The exhibition will be opened on May 1, 1901, and will remain open for six months. It is not yet arranged as to whom will perform the opening ceremony, but it is believed that it will be accomplished as before, by a member of the royal family.

A HOUSE was recently moved in Wellsville, Ohio, by electric power taken from a trolley line. The house was being moved along the street where there was an electric car line. Two cars were hitched to the house by a rope, and it was quickly pulled to its new destination.

LAUNCH OF THE MONITOR "WYOMING."

The "Wyoming" is one of four similar vessels which were authorized in May, 1898. The others are the "Arkansas," building at Newport News; the "Connecticut," building at Bath, Me.; and the "Florida," which is under construction at the Lewis Nixon yard, Elizabethport, N. J. These ships represent the modern development of the monitor type of warship, and in them an attempt is made to mitigate as far as possible the inherent defects of a system of design which, while it was well suited to the rivers, bays and shallow waters of the civil war, is ill adapted to the requirements of a modern warship, which should be capable of keeping the sea and casting loose its guns in almost any kind of weather.



SINGLE-TURRET, HARBOR-DEFENSE MONITOR "WYOMING."

Displacement, 3,235 tons. **Speed,** 12 knots. **Normal Coal Supply,** 400 tons. **Armor:** Belt, 11 inches; turrets, 10 inches; barbettes, 11 inches; deck, 1½ inches. **Armament:** Two 40-caliber, 12-inch B. L. rifles; four 4-inch R. F. rifles; two 6-pounder semi-automatics; eight 1-pounder automatics. **Complement,** 131. **Date,** 1900.

However, within the limitations of her type, the "Wyoming" is a serviceable vessel, for she is heavily armed, well protected, and with her modern motive power and for a monitor superior accommodation, she will prove to be economical and comfortable. The four vessels were authorized largely in response to the symptoms of hysteria that developed among the citizens of some of our large Eastern seaboard cities when they imagined themselves threatened by the guns of Cervera's hapless fleet, and it is probable that the new monitors will find a permanent station in four of our most important Atlantic harbors.

The "Wyoming" was launched at the Union Iron Works, San Francisco, on September 8, in the presence of His Excellency the Governor of Wyoming and an enormous crowd of spectators. While a powerful vessel, the "Wyoming" is considerably less in dimensions compared with the "Monterey," though both are practically of the same type. The "Monterey" is 255 feet in length, and is 59 feet beam, with a depth of 14 feet 10 inches. The "Wyoming's" dimensions are: Length, 252 feet; beam, 50 feet; and mean draught, 12 feet 6 inches. The side armor of the former vessel is 13 inches in greatest thickness, tapering to 8 inches at the ends; of the latter, 11 inches, tapering to 3 and 5 inches. Displacement: "Monterey," 4,084; "Wyoming," 3,235; horse power engines, 5,244 and 2,400 respectively; speed, 13·6 and 12.

The armament of the "Monterey" consists of two 12-inch and two 10-inch main battery, six 6-pounders, four 1-pounders, two Gatlings. Of the "Wyoming," two 12-inch, four 4-inch rapid fire, two 6-pound semi-automatic, four 1-pound automatic, and additional four automatic 1-pounders have been authorized.

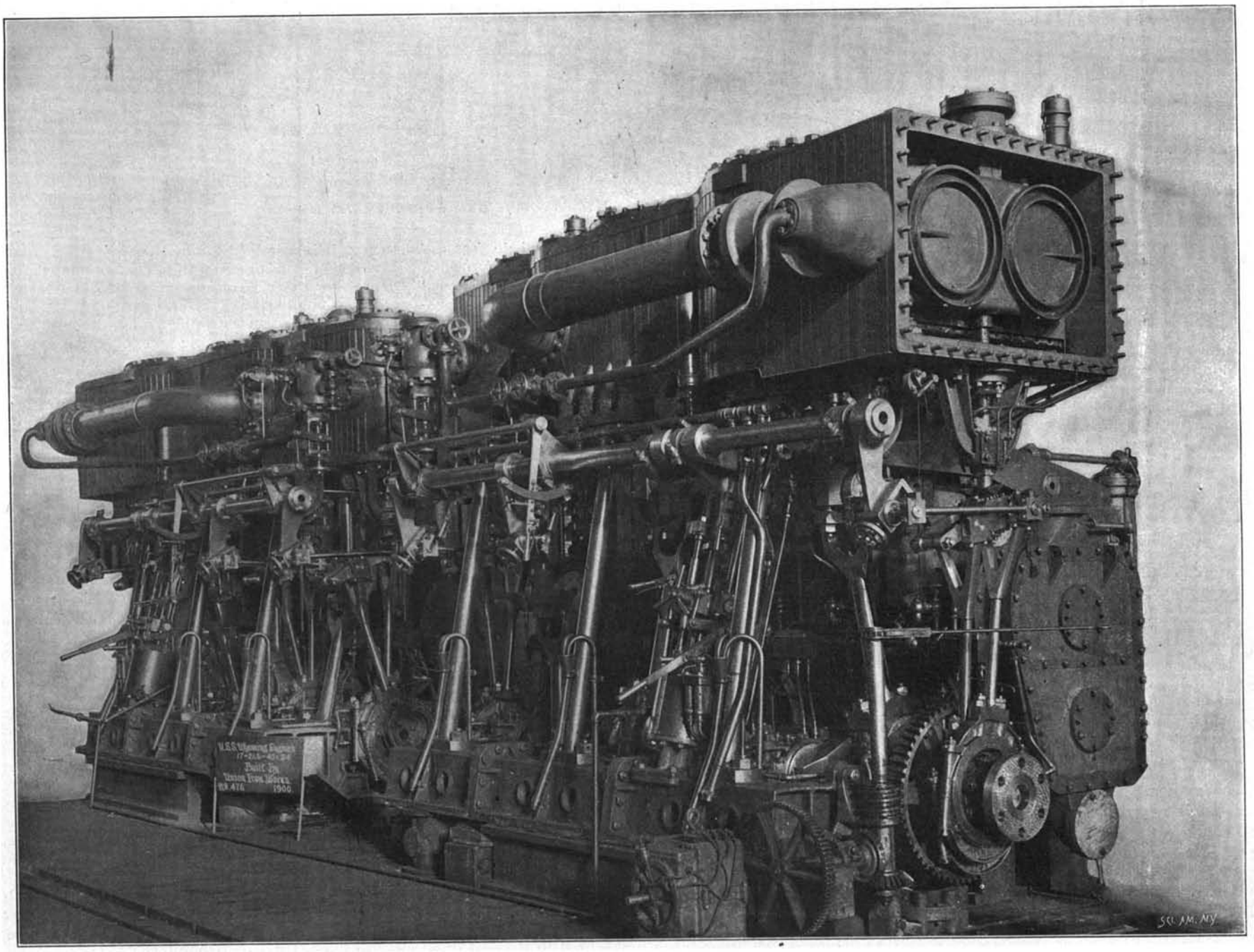
Although the "Wyoming" will carry only two heavy guns, as compared with four carried by the "Monterey," the increased power of her two 12-inch rifles, due to greater length and smokeless powder, is such that one round from them will have 12,800 foot-tons more energy than one round from the four guns of the larger vessel.

The keel of the new monitor was laid in October, 1899, and her completion is promised in six months.

Signaling With Kites.

A system of war signals with colored parachutes in midair was tested September 29, by W. A. Eddy, of Bayonne. A light box 3 feet square was sent up by two 9-foot kites. The box was divided into two compartments, each provided with a trap door and each contained an American flag and a folded paper parachute. One of the parachutes had secured to it a disk of silvered paper. The flashing of the sunlight upon such a disk can be seen a long distance. The trap doors were secured by lighted time fuses, and one was timed to release the door in five minutes, and the other in ten minutes. When the parachute box reached a height of 500 feet, the first match released the door and the parachute sailed slowly away with the flag flying. The kites then carried the box up higher before the second compartment was opened by the other fuse. The idea is to use different colored flags suspended in series under the parachutes, so that messages can be sent aloft, where they can be readily read at a considerable distance by the aid of glasses.

THE Russian ice-breaking steamer "Ermak" is being lengthened and the form of the bow has been altered.



TWIN VERTICAL TRIPLE EXPANSION ENGINES OF THE "WYOMING."—INDICATED HORSE POWER ON TRIAL, 2,400.

AN INGENIOUSLY WHITTLED FAN.

On a street corner near City Hall Park in New York city, an industrious old blind man has for years plied a brisk trade in selling the fans which he dexterously whittles from a single piece of wood to the undisguised admiration of the many small boys who gather about him.

The blind man's tools are a jack-knife and a tub of water; his material a piece of soft white pine 12 or 14

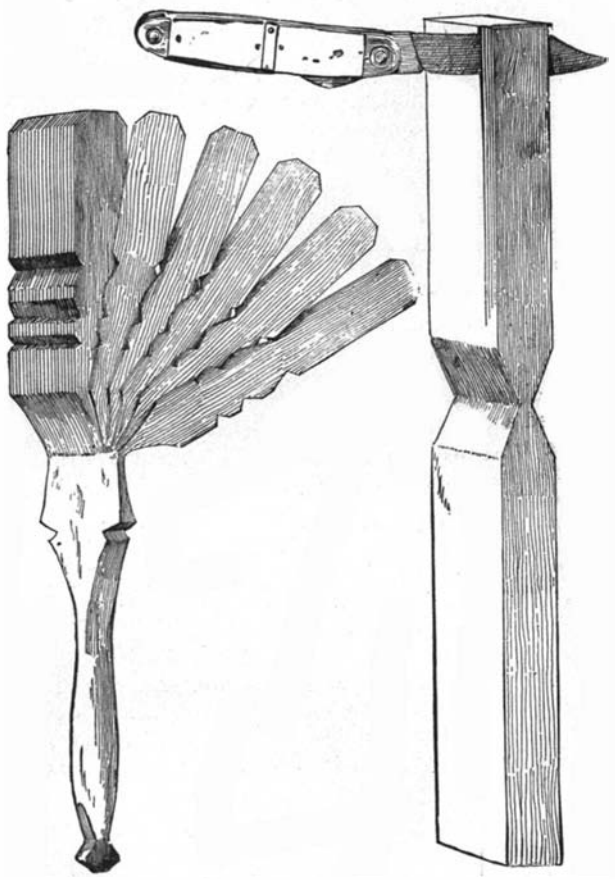


Fig. 1. Fig. 2.

HOW THE FANS ARE MADE.

inches in length, 2 inches in width, and about an inch thick. Notches are made in each side of the piece of wood somewhat above its middle point, a thickness of one-quarter of an inch being left between the notches. The shorter end of the wood is split downward, as indicated in Fig. 2, as far as the notches, into sections about $\frac{1}{16}$ of an inch thick. From twenty-five to thirty-five parts or blades are needed to make a good fan. To form the handle of the fan, the lower, longer portion of the wood is partially sectioned to form small auxiliary fans, or merely thinned down to form a handle. The blades, after having been thus produced, are notched, as shown in Fig. 1. The wood is then thoroughly soaked in a tub of water, and the blades bent to form a fan of the form illustrated in Fig. 3.

ELECTRICAL DREDGE FOR THE VOLGA RIVER, RUSSIA.

In the whole field of civil engineering it would be difficult to find a device which has done more to expedite the construction of works that involve the handling and removal of great masses of material than the powerful suction dredges which are associated with the name of Lindon W. Bates, an American engineer. In a recent issue of the SCIENTIFIC AMERICAN we illustrated the big dredges which are in use by the United States government on the Mississippi River, and of these the "Beta" is credited with a record of between seven hundred and eight thousand cubic yards of material handled in one hour. One of the most recent machines of this class to be constructed is the powerful double dredge that forms the subject of our illustration, which was built for the Russian government dredging operations on the Volga River.

In designing the Volga dredges Mr. Bates introduced several novel features, which were intended to economize time in the maneuvering of the dredges themselves and of the pontoon pipes by which the dredged material is conveyed and discharged. A distinctly novel feature is the use of electric power for these purposes, the movements of the dredges and of the pipes being controlled by twelve separate electric motors, disposed on the dredges themselves and upon the pontoons. In order to allow the dredge to be taken through the canals by which she had to pass from the Baltic to reach the Volga River, the dredge was constructed practically in two halves. Each of the two hulls is constructed of steel and is covered with a 3-inch pine deck, above which is built a deck-house and a pilot-house of light frame composition. At the bow, recesses are formed to accommodate the "suction ladders." A few feet back from the bow, one on each side of the hull, are two triangular recesses, which are cut away to accommodate a pair of screw propellers. Each screw shaft is direct-connected to a 125 horsepower electric motor. The shafts are arranged at an angle of about thirty degrees with the center line of the vessel, and they not only co-operate with the twin propellers at the stern in driving the vessel ahead or astern, but they assist in swinging the dredge to right or left when the operation of dredging is in process. The twin propellers at the stern are also each direct-connected to a 125-horsepower motor. Two 30-horsepower motors are carried on each pontoon line, one of which extends from the stern of each half of the dredge. The four motors on each dredge and the motors on the pontoons are all connected with, and can be controlled from, the pilot-house. The electric current is furnished by a 600-kilowatt generator, directly connected to a fore-and-aft triple-expansion engine, which is clearly shown in our illustration. The engine has cylinders as follows: high pressure, 14¼ inches; intermediate, 22¾ inches; and low pressure, 37⅜ inches diameter, the stroke being 24 inches. At a speed of 200 revolutions per minute the indicated horse power is 800.

Of course, the most important feature in a dredge of this type is the main centrifugal pump, which is located amidship. The runner makes from 150 to 180 revolutions per minute. It is driven by a divided, vertical, triple-expansion engine, one set of cylinders being carried on the starboard and the other set on the port side of the pump, the whole being connected upon one shaft. The high pressure cylinder is 21 inches in diameter; the intermediate, 34 inches; and the low pressure, 39 inches in diameter; the common stroke being 24 inches. The indicated horse power is from 1,425 to 1,600. Steam for the whole steam plant is supplied by eight Babcock & Wilcox boilers, four on each hull. These are fired exclusively with naphtha, which is fed to each boiler by four burners, the spraying of the naphtha being accomplished by a steam jet.

The dredged material is brought up by means of

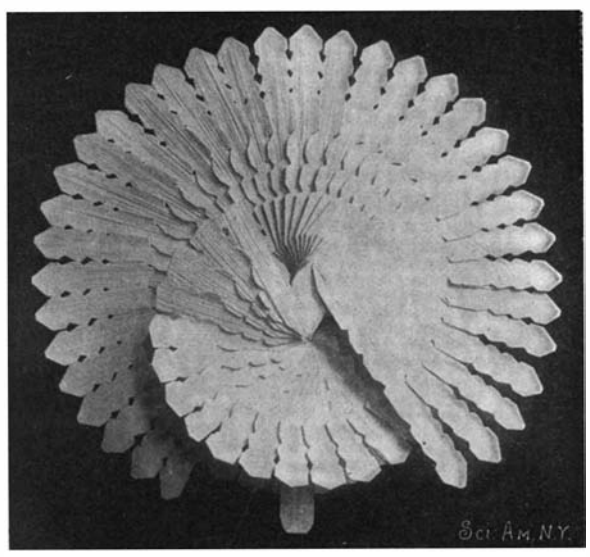
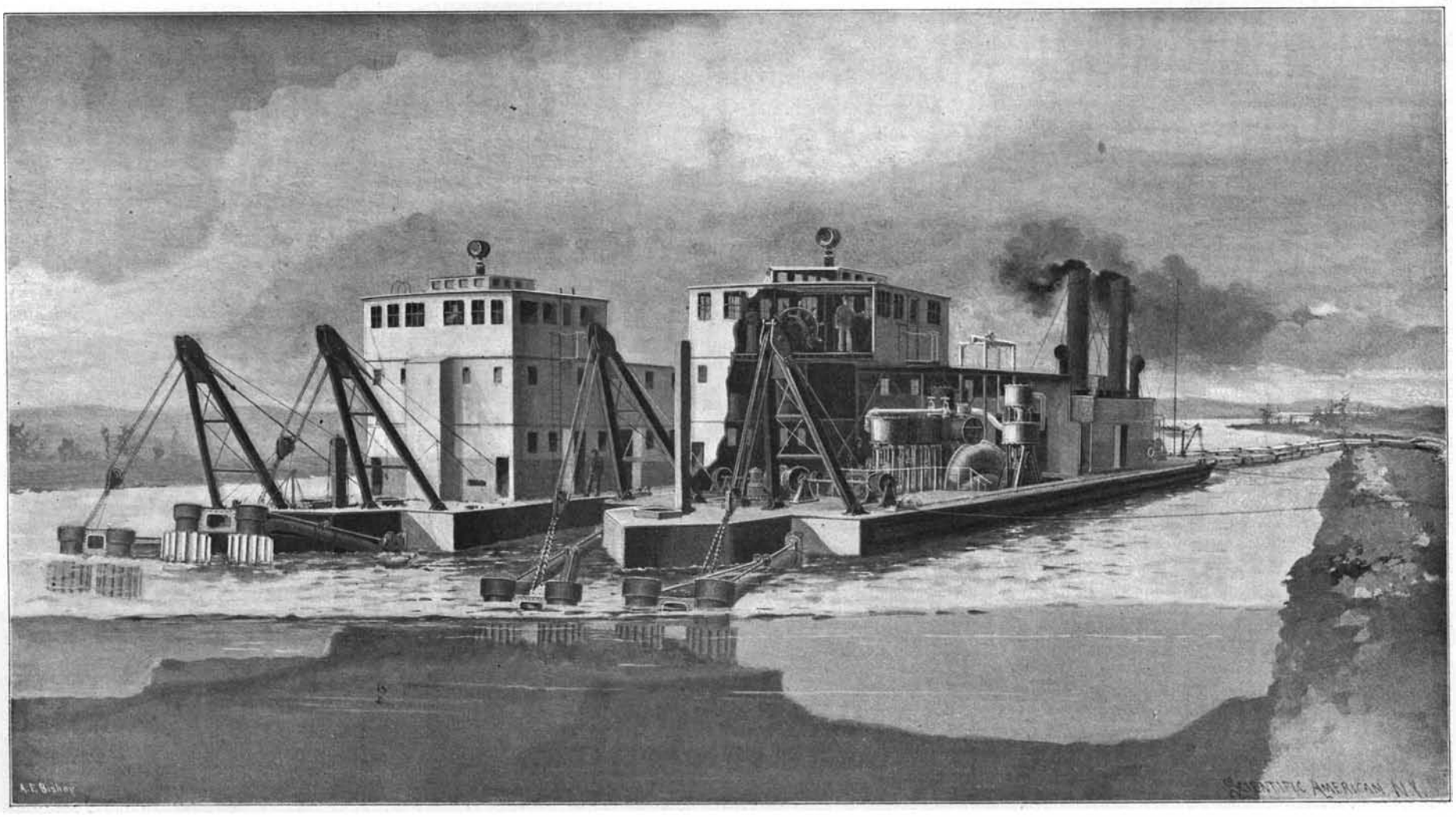


Fig. 3.—A COMPLETED FAN.

four suction pipes, which are attached near the bow of the dredge and hinged upon a common horizontal axis on the dredge. They are raised and lowered by means of derricks, two of which are attached at each bow, and they are capable of dredging to a maximum depth of 16 feet. The lower ends of the four suction pipes on each dredge are inclosed by rotary cutters, which are rotated by means of miter gears and shafting which are attached to the suction pipes and move with them. Each set of shafting is driven by a cutter engine, which is located in the forward part of the hull. It will be seen from our illustration that the suction pipes and cutters form two ladders, supported one on either side of each hull, and approaching each other just in front of the stem of the bow, the four cutters being spaced at equal distances from each other, the width from outside to outside being slightly more than the extreme breadth of the dredge.

Some novel features are embodied in the pontoons, which, with the exception of one at the extreme ends



POWERFUL ELECTRICAL SUCTION DREDGE FOR THE RUSSIAN GOVERNMENT—CAPACITY, 7,000 CUBIC YARDS PER HOUR.

of the respective lines of discharge pipe, are all of similar construction. Each pontoon is 50 feet in length from center to center of its couplings. The cross-section of the pontoons is elliptical, the horizontal axis measuring 9 feet 3 inches, and the vertical axis 3 feet 3 inches. The discharge pipe, which is 33 inches in diameter, is built through the center of the pontoon, the pontoon proper thus forming a sort of elliptical jacket which incloses the pipe.

Accommodations are provided for seventeen officers and men, some above and some below the main deck, and the dredge is provided with a tender in the shape of a stern-wheel steamer, 125 feet in length and 26 feet in beam, which is fitted with comfortable quarters for the officers, and with bunks for ten men, besides all necessary living arrangements. On the main deck is a machine shop which includes a lathe, a drill press and shaper. The dredge is electrically lighted throughout and the pilot-house is provided with a searchlight. Another important feature of the outfit is an oil barge to carry the necessary fuel for the boilers. This barge is 80 feet long by 20 feet beam, and has a total capacity of 130 tons. The dredge was built by the Société Cockerill of Belgium, which is one of the best known iron shipbuilding companies in Europe.

Prior to its departure for St. Petersburg the dredge was given a very thorough trial, with the result that each half of the dredge was officially determined to have a dredging capacity of 3,500 cubic yards per hour, a total for the complete dredge of 7,000 cubic yards per hour. The success of the electrically-driven propellers for maneuvering the dredge was shown in these tests by the fact that, when working on a course where there was a current of from three to four knots per hour, the dredge could be easily maneuvered with but one line ahead under circumstances where, with the ordinary type of dredge, half a dozen lines would have been necessary for anchoring the dredge and swinging it.

Electrical Notes.

The Hamburg-American liner "Augusta Victoria" has been equipped with an automatic telephone pay station, enabling passengers to use local or long distance telephones up to the time of sailing. Just before the lines are cast off, a plug is removed from the back, cutting off the connection. If the scheme is found to work satisfactorily, other steamers of the company will be similarly equipped.

In Buda-Pesth there is a news telephone, and its object is to keep its 6,000 subscribers supplied with all the latest news. The service has a main wire 168 miles in length, and it is connected with private houses and various public resorts. From 7:30 in the morning until 9:30 in the evening, twenty-eight editions of news are spoken into the transmitter by ten men possessing loud clear voices, working in shifts of two. The news is classified and given in accordance with a regular programme, and the service has been eminently successful.

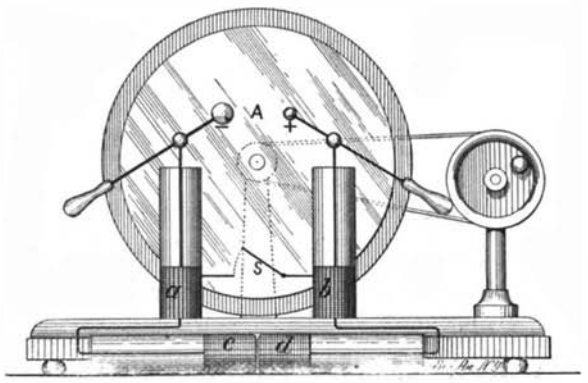
A very ingenious and amusing diversion has been on exhibition at the Crystal Palace in London. This is the Luminscriptor, or writing by light. It consists of an ingenious contrivance by which portraits or sketches are drawn, and transmitted by electricity on the screen in full view of the spectators. The exact means by which the effect is attained is a secret jealously guarded by the operator, but it appears to be somewhat an application of the pantograph, only in this instance, instead of the picture being drawn upon a larger scale than the original, it is reduced in size. The operator makes his original sketch upon a piece of paper or board about 13 inches square. By means of an electric current this drawing is transferred, line by line, to a small piece of specially prepared blackened surface upon glass, about one inch square, and then projected upon the screen by the limelight in the same manner that photographic slides are projected by the optical lantern. As the artist draws his sketch upon the original board, so it is transferred to the blackened glass, and is projected upon the sheet.

Work is now being carried on in London for the laying of the telephone wires which are to be used in connection with the government scheme of supplying the citizens of the metropolis with an efficient telephone controlled by the Post Office. All the important thoroughfares in the city are torn up, much to the inconvenience and annoyance of the pedestrians and derangement of traffic. The system is to extend from the city to the outlying suburbs, and will cover an area of 640 square miles when completed. It is estimated that the task of laying the wires will occupy at least a year. The work is being pushed forward with all possible speed, and the manufactories of the necessary materials are being maintained at their highest pressure of production. The exchange will be located in Queen Victoria Street, in the building occupied at present by the Post Office Savings Bank. A new home for that department is in course of erection in another part of the city. All the trunk lines, which at present are concentrated at St. Martins le Grand, will be transferred here as soon as the necessary alterations are carried out. The huge switchboards of this exchange will be worked on the central battery or glow-lamp system. The most salient characteristic of this state service is that it will become a powerful rival to the National Telephone Company, which hitherto has had the monopoly. The state proposes to offer a system so cheap that many private houses will be supplied with the telephone. The subscriber can either pay a certain sum annually, which is not to be more than $50—this is exactly half what is at present charged by the private company—or he can subscribe to it on the toll service. In this case the subscriber will pay a small initial sum of about $15, which will practically defray the actual expense incurred by the state for installing the instrument in that particular building, and he will then be charged a toll of two cents every time he rings up the exchange, paying nothing when he is rung up.

ACCELERATION OF THE SPARK DISCHARGE IN STATIC MACHINES.

BY HOWARD B. DAILEY.

One of the inevitable experiments with an influence machine is the exhibition of its spark discharge. As an aid in the production of extra rapid, full length Leyden jar discharges for purposes of display, the spark-multiplying device here described is of great service. In the diagram, *a* and *b* are the usual condensers of a static machine. A switch, *S*, facilitates the convenient connection or disconnection of their outer coatings. Two auxiliary or secondary condensers, *c* and *d*, about equal in size to the primary ones, have their inner coats connected, as shown, with the outer coats of the primary jars, the outside coatings of the secondary jars being in contact or joined by a switch similar to *S*. If *S* be opened while the machine is in operation, the free exchange of electricities ordinarily taking place between the outer coatings of *a* and *b* during their charging and discharging process is interfered with to some extent by the interposition within the extra or shunt circuit of the jars, *c*



SPARK MULTIPLIER FOR STATIC MACHINE.

and *d*, which experience a certain degree of electrification at each spark occurring across the air gap at *A*.*

The effect of this action upon the primary condensers is to prevent their complete discharge, thus leaving them partially filled after the passage of each spark, and therefore in condition to have their striking potential re-established much sooner than would be the case after full discharge. Experiment shows that with a given length of spark at *A*, the succession of flashes becomes more than twice as rapid when *s* is opened; though of course the density of the sparks is proportionately reduced. The mild induced currents passing between the outer coats of *c* and *d* during the display at *A* are of a character peculiarly desirable for a certain class of experiments requiring small volume with comparatively high frequency, such as the illumination of Geissler tubes, physiological effects, etc. If *S* be left open and the outer coatings of the secondary jars disconnected, the discharge becomes a beautiful mixture of brush and sparks; but the sparks, now extremely thin and in enormous numbers, lose their bright bluish appearance and become a dull red. The device is of especial value with the sectorless Wimshurst. As is well known, such machines exhibit much higher efficiency than those with sectors. They possess, however, one serious defect, viz., in order to have any large percentage of their full power realized, considerable resistance is necessary in the air gap; so that while with a long working spark the sectorless machine is greatly superior to its sectored prototype, with the short gap necessary for very rapid condenser discharges its potential suffers serious diminution, which in many cases may even terminate in total extinguishment of electrical action. The double condenser device overcomes this difficulty by enabling the operator to obtain the desired rapidity of discharge with the use of long sparks, and consequently sufficient resistance at *A* to keep up the normal potential of the plates. This interesting arrangement is due to Mr. Edwin Palmer, of Battle Creek, Mich.

*To obtain the longest discharges with certainty and regularity, the negative ball at the spark gap should be about five times the size of the positive. Mention of this very important fact is neglected in many otherwise excellent descriptions of static machines.

Engineering Notes.

The calorific value of the average London domestic refuse has been estimated at about 0·99 pound of water from and at 212° Fah. per pound of refuse burnt. It is calculated that the total amount of power per annum which could be obtained from the whole of the refuse in London if burned in suitable furnaces would amount to 133,000,000 brake horse power hours.

At the Silver Works Company, of Antwerp, has recently been completed an immense chimney shaft 410 feet in height. The interior diameter of the structure at the base is 25 feet, tapering to 11 feet at the summit. This chimney, however, is not the tallest stack in the world, inasmuch as it is not so tall as the celebrated Townsend stack at Glasgow, which towers 468 feet into the air.

The tramp question in the United States has been a most serious one ever since the introduction of railroads. It is estimated that no less than 10,000 are carried nightly on trains, and that 10,000 more are waiting to steal a ride at the same time. The Pennsylvania Railroad has taken a firm stand in the matter, and has equipped a special police force for the purpose of preventing trespassing. Some of the farmers, however, do not approve of this action, as they obtain much of their extra help in harvest times from the drifting population.

Owing to changes in the railway line several villages in South Dakota have been cut off from the railroad. The result is that the villages have moved to the new location. In the towns of Bloomington, Edgerton, Old Platte, Castalia, and Old Selby one building after another was put on skids and towed across the prairie by means of horses and thrasher engines, says The Railway Review, and in one instance a structure 40 by 300 feet was moved three miles, while its contents of merchandise were not disturbed, and trade was being carried on all the time.

An interesting record of the number of locomotives upon twenty of the principal railways in England has just been compiled, and it gives a very good idea of the progress of locomotive building and the development of the railroads in Great Britain. There are in all 16,451 locomotives in operation upon these railways, which is an increase of 277 upon the contemporaneous returns of 1899. The railroads possessing the greatest number of engines are the Midland, 2,597; the London and North-Western, 2,464; and the North-Eastern, 2,083. Three other leading railways each possess over 1,000 engines.

The British War Office is carrying out some experiments with the new patent boot that has been invented by Capt. Loderer, of the Austro-Hungarian army. This device consists of a leather sole, under the heel of which is a contrivance of metal with a long spiral spring inside. The patent is so simple that it can be readily attached to the ordinary boot. The object of the spring is to obviate any jar when placing the foot on the ground, so that it is like putting the foot upon a cushion. Besides this advantage, it also acts as a pleasant ventilator to the foot. The boot has been submitted to prolonged experiments in the Austro-Hungarian army, with distinct success. It renders walking easier, considerably reduces the fatigue of marching, while soreness of the feet is entirely prevented. Before introducing it into the army, the British authorities are testing it among the postmen, who have to tramp long distances in the performance of their duties over hard streets, which is particularly tiring work. If the boots prove successful in this case, they will be distributed among the troops, by whom they will be welcomed, since the present regulation boot is not conducive to comfort or ease during a long march.

The shipbuilding industry of the Clyde, which during the last few months has been very quiet, owing to the war, is now receiving a decided stimulus. Several of the large firms have received orders which will tax their highest pressure of working for several months to come. The Clyde Shipbuilding and Engineering Company has received orders for two steamers of ordinary dimensions, five sets of engines for vessels now in course of erection in their own yards, and several orders for sets of triple expansion engines. Indeed, they have such an abundance of work in hand that they are not at present in a position to entertain fresh orders. Three other well-known firms are also blocked with work, while Messrs. Russell & Company, who have always their capacity of thirteen keel stocks, equal to 70,000 tons, in full swing, are refusing work. Fortunately, very few orders are for immediate delivery. The shipbuilders are experiencing great difficulty in obtaining the necessary materials, and this deficiency is hindering their output to a very great extent. If the supply of material were greater, or at least equal to the demand, work would be hastened considerably. The orders for vessels show no sign of abating, and the Clyde has consequently assumed its former scenes of great activity, which must continue for several months to come.

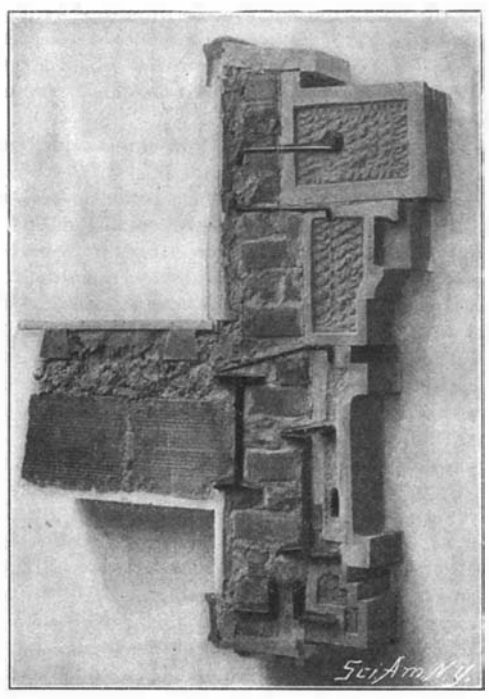
"BROADWAY CHAMBERS."—EXHIBITS AT THE PARIS EXPOSITION.

In the United States section of the Civil Engineering building is an extensive exhibit showing the construction of a modern office building, as exemplified by the "Broadway Chambers," one of the large buildings recently erected in New York. The exhibit, made by Geo. A. Fuller & Company and the sub-contractors, is intended to show the revolution which has taken place in America within the last few years in constructions of this kind, and at the same time the rapidity with which the construction may be carried out. Owing to the use of the steel skeleton which forms the framework of the building, the masonry need not be as massive as that formerly used; in fact, the walls serve mainly as a protection against the weather and for architectural beauty, and the stability of the building depends entirely upon the steel frame.

The exhibit shows the construction of a building of this kind in a very complete manner. As will be seen in the illustrations, a model shows the skeleton frame and a plaster model shows the appearance of the exterior. This skeleton frame was illustrated fully in the SCIENTIFIC AMERICAN of May 12. In the rear of the exhibit is a full-size model showing the terra-cotta finish of the upper stories. A number of full-size sections illustrate the methods of construction of all the essential parts of the building. The engine and dynamo for the electric lighting, with the switchboard, are also shown.

A view of the metallic model is seen in one of the illustrations, showing a modern steel frame complete, with all its details. To support the framework, a layer of cement 30 inches thick is placed upon solid ground, and upon this rests the grillage, composed of I beams placed side by side and crossed in two or more layers. From this the main posts rise to the top, joined laterally at each story by the main cross-beams with their floor-beams. The iron work is entirely protected by blocks of porous terra-cotta, completely incombustible. The main posts are generally constructed of channel bars and flat plates riveted together by Z iron with plates, or of trellis work, according to circumstances. The main cross-beams are generally I or channel iron; as will be noted, the corners of the building are reinforced by gussets. At each story the skeleton frame is surrounded by angle-iron, which serves to support the facing. All the iron or steel parts are specially treated; they are first well cleaned to remove all traces of grease or dust, then given a coat of pure linseed oil, and afterward two coats of metallic paint; after erection they are given a thick coat of silicious and graphite paint. To the left of the illustration will be noticed a full-size section of one of the main columns, showing how it is surrounded by terra-cotta, with the holes for the various pipes and conduits, and the exterior finish of plaster. To the right are two full-size models showing the method of joining the beams.

The roof is constructed in the same way as the beams of the main stories; it is covered with a water-proof layer, then with cement covered with terra-cotta tile. The steel model shows in miniature the arrangements for heating and ventilating, plumbing, elevators, etc. The heating system is carried out upon the most improved plan; it is capable of maintaining a uniform temperature of 70° F. when the outside is at 0° F. The radiators utilize the steam which has just served for the electric lighting and other power of the building, and which would be otherwise lost. When at very low temperatures this is not sufficient, it is supplemented by a direct admission of steam from the boilers, carried out by a pressure-reducing regulator which enables the boilers to feed the steam-heating system without losing pressure. The main steam-pipes rise from the basement to a space between the last story and the roof, and from these are connected horizontal branches which then descend vertically to supply the radiators in the different stories. This system is clearly shown in the model by miniature colored pipes. There are two Clonbrock boilers in the basement, which are connected with a chimney 240 feet high and over three feet in diameter; the boilers, of the water-tube type, are also shown by models. All the exposed parts of the boilers and steam fittings are protected by a magnesia covering 1½ inches thick. The engine, of the Payne type, has a capacity of 100 horse power, and is direct connected to a Bullock dynamo which can supply 650 lamps. The current passes to a distributing switchboard, which controls all the lamps in the building.



SECTION OF SPANDREL, SIXTEENTH FLOOR.

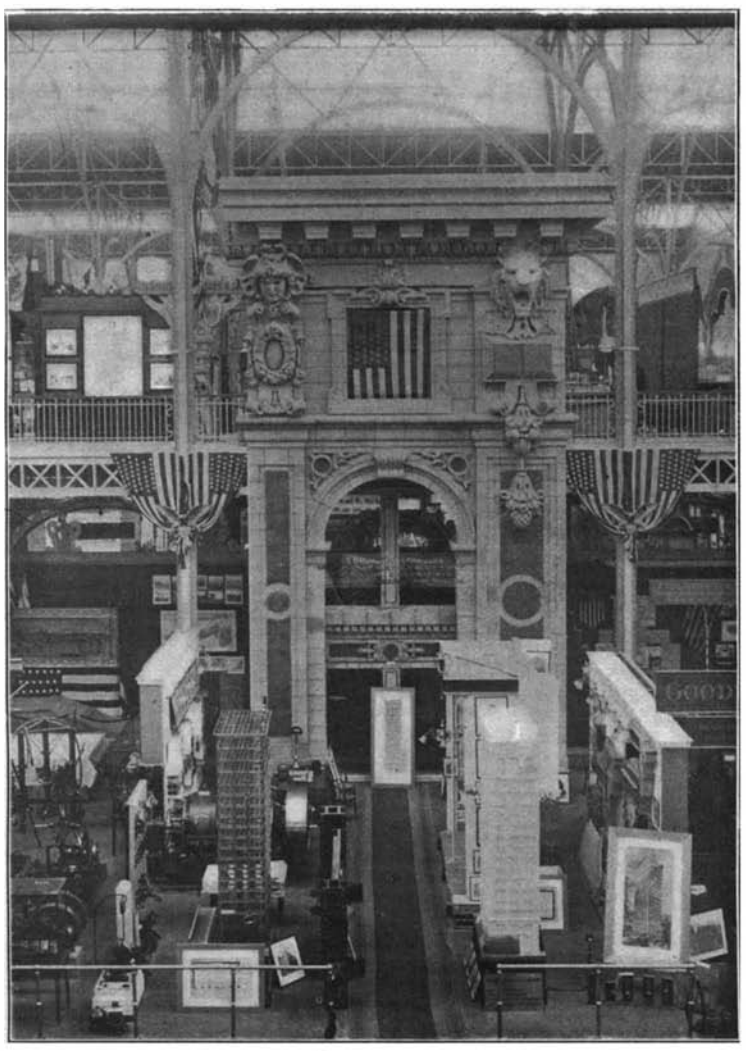
The plumbing and drainage systems are carefully carried out; they have been installed according to the New York Health Department rules. The hot and cold water pipes are tested at a pressure of 150 pounds per square inch. There is a complete fire system, connected directly with the street mains and fire pump, including pipes, valves and hose. The roof, drainage and ventilating pipes which lie above the soil are in galvanized wrought iron, with screw joints. The tubes exposed to view in the washstands and closets are of copper, nickel-plated; these copper tubes are made without soldering and annealed, hard metal tubes being excluded from the building. The model also shows the four large hydraulic elevators of the Otis type which give access to all parts of the building; one of them is caused to mount and descend by a small electric motor arranged for the purpose.

The plaster model shown in one of the illustrations gives a good idea of the exterior of the building; it has been made to a scale of one-half inch to the foot, the actual height of the building being 230 feet. The façade is of granite from the ground floor to third story, in hard brick from the third to the fourteenth story, and in terra-cotta to the top. The courses of brick have been arranged to give horizontal lines and diminish in this way the appearance of height. The full size model in the rear of the exhibit is a reproduction of a portion of the upper stories as they actually exist in the building. The general color of the terra-cotta is buff relieved by polychrome panels. The terra-cotta is hard, nearly vitreous and quite non-absorbent; the joints are carefully filled and covered to prevent moisture from entering.

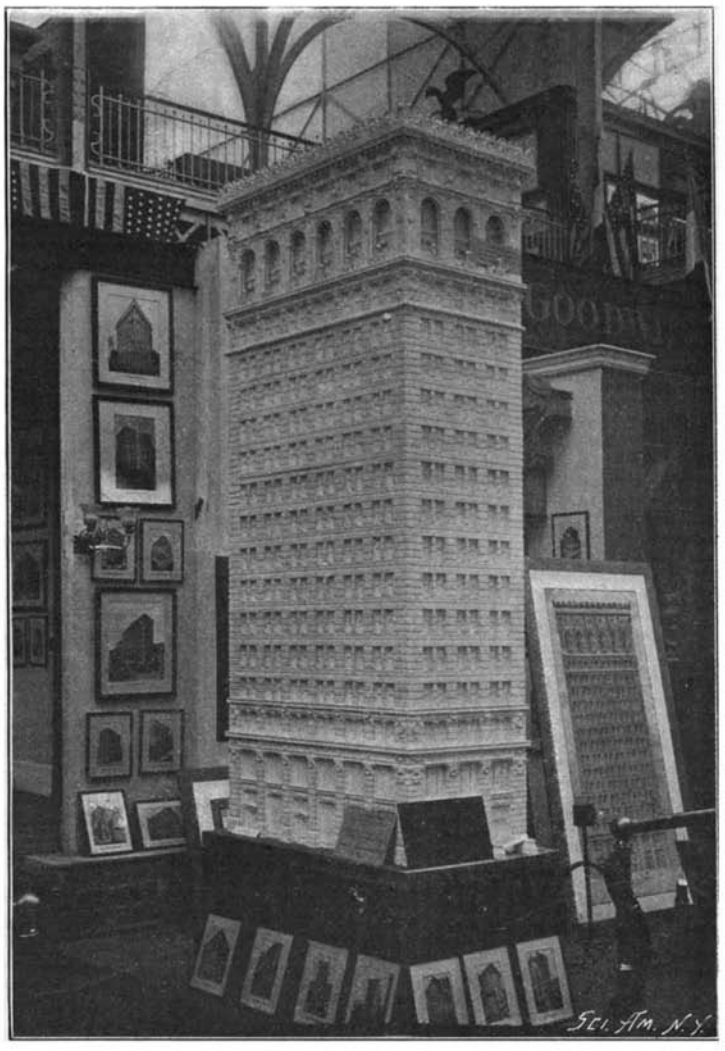
The full size section exhibited shows the general arrangement of the offices and the incombustible construction of the walls and floor, also the disposition of the various conduits. The principal corridors, as well as the ground floor and the banking floor, are finished in marble, and the remainder in cement or tile. In the section will be seen the main beam in the rear and two of the floor beams; between the latter is laid the floor; this, with the exception of the second basement, is composed of arches formed of hollow blocks of terra-cotta ten inches thick. Above these is a layer of beton formed of cement mortar and broken terra-cotta; in this are laid the wood sleepers, as shown, and to these is nailed the floor planking.

Another full size section is that showing a portion of the front of the building, in which the construction is clearly seen. The terra-cotta pieces forming the front are attached by anchors to the main beams of the building. The ceiling of one story is seen below, with the top of window, then the arrangement of the floor, the terra-cotta blocks, sleepers and planking and a portion of the wall of the upper story, with the interior finish and window-sill.

The exhibit contains a number of photographs of this building, and of similar buildings erected on the same system in different cities, notably in Chicago. A set of progress pictures taken during the construction of the "Broadway Chambers" shows the rapid progress which may be made with this construction; the building was completed within seven months after the ground was broken. The building was designed by Mr. Cass Gilbert, architect, with Purdy & Henderson as consulting engineers. The Paris exhibit is ably superintended by Mr. Robert E. Fuller.



FULL-SIZE TERRA-COTTA SECTION OF "BROADWAY CHAMBERS."



PLASTER MODEL OF "BROADWAY CHAMBERS" AT THE PARIS EXPOSITION.

IN Cologne all automobile vehicles must be provided with a number large enough to be read at considerable distance, and every operator must have a certificate issued by the police authorities. Bells must be used instead of signal trumpets, and the vehicles must also have two brakes.

Some Famous "Nefs."

The late Duke of Saxe-Coburg indulged in many curious and artistic hobbies, one of the most enthusiastic of which was the collection of antique "nefs," or small models of ships executed in silver. These quaint yet valuable specimens of the silversmith's handiwork are, unfortunately, very rare. The British Museum, at London, does not possess a single example, and the South Kensington Museum is but indifferently represented. The Czar of Russia possesses what is generally believed to be the finest "nef" extant, presented by Queen Elizabeth of England to the then Czar. Yet the late duke possessed a collection of more than forty "nefs." Naturally, he was an expert in connection with this unique craft, and he always displayed a keen delight in exhibiting his specimens to his friends. His collection is undoubtedly the largest and finest in existence, since it includes some of the most beautiful specimens that have been manufactured in the sixteenth, seventeenth and eighteenth centuries. Curiously enough, very little is known regarding the early history of these curious craft, but in the olden days such models were frequently presented by one royal personage to another. Their avowed purpose was to constitute a table ornament and a receptacle for wine. They were constructed with the greatest care and skill, and unstinting pains were taken by the smiths to render them faithful in design even to minutest details of the vessels of which they were the models. As historic relics they are of inestimable value, since the rigs and characteristics of the battleships and merchant vessels of the various periods, being absolutely correct, render them far more reliable for reference than any amount of drawings or prints.

The public had an opportunity of inspecting the duke's collection in London, in 1891, at the Royal Naval Exhibition, in which they constituted a conspicuous feature in the Loan Art Section. The models displayed were all magnificent examples of old French, old Dutch, Nuremberg, or Augsburg handiwork, and were freely embellished with intricate and beautiful detail. One of the finest, also the largest, was a model of the "Felicitas" made at Nuremberg. The vessel is three-masted and is executed throughout in parcel gilt. She is shown under full sail with fighting tops on the masts, while a triumphal procession of Neptune and the sea gods is delicately chased in the silver hull. As an example of the enormous skill that was devoted to the work to render the model a complete vraisemblance of its prototype, there was a smaller craft, upon the deck of which were grouped the sailors, soldiers, men, and women, while guns are shown on the decks and others with their muzzles projecting from the portholes. One, hailing from Augsburg, is mounted with twelve silver cannon, has the head of Pan at the bows and a flag flying at the stern. The hull, as in most of the other vessels, is inscribed with a design. In this case it is sea nymphs bearing the inscription "Clytus Rex Oceanus." Reality is further imparted to this specimen by the sailors represented at their duties in the rigging. Not long before he died the duke added another valuable example to his collection. This model portrayed a battle between Vasco de Gama, the explorer, and black warriors, probably depicting some incident that occurred on one of his voyages.

The friends of the late duke, knowing the unbounded enthusiasm he evinced in collecting these nefs, were always ready to inform him where other models might be obtained, and the duke never regarded any price that might be demanded as prohibitive, since he was perfectly aware of the immense intrinsic value of these diminutive craft. When the duke celebrated the twenty-fifth anniversary of his connection as one of the Brethren of Trinity House, his colleagues of that corporation presented him with one large model, nearly two feet in length, of a trader, made in Nuremberg in 1850, which he greatly prized.

The manufacture of these nefs appears to have long since fallen into desuetude. Their cost was great, which fact no doubt served to render them prohibitive except to the most ardent collectors, and this fact probably accounts for their great scarcity. The craft was somewhat revived some years ago by two models which were manufactured of the English ships "Britannia" and "Victoria," which were presented to the Queen of England by the Royal Navy and Marines on the occasion of her Jubilee in 1887. For the modeling of the first-class battleship "Victoria," which was sunk by collision with the "Camperdown" in the Mediterranean some years ago, a set of exact drawings were prepared. Some idea of the fineness of the work required on this occasion may be gathered from the fact that each gun of her Nordenfelt armament, though it contained no less than one hundred and eighteen pieces, only weighs half an ounce, and can be placed upon the ordinary English florin, which is only about one inch and a quarter in diameter.

There is much speculation as to what will become of the duke's collection of these nefs, but it is suggested that they should be presented to the English nation as a memorial of one who devoted so much of his time to the English navy, and to whom the welfare of the personnel of which was constantly at heart. At present the collection rests in large glass cases at the late duke's residence, Clarence House.

October Building Edition.

The Building Edition of the SCIENTIFIC AMERICAN for October is a particularly handsome number. The colored cover illustrates a model dwelling at Montclair, N. J. Among the other interesting features of this edition are the Music Pavilion, Golden Gate Park, San Francisco, Cal., "Some Italian Towers," which portray in an artistic manner a number of Italy's finest monuments, and a number of interesting houses, as well as a simple summer cottage at Deal Beach, and a modern stable.

The Current Supplement.

The current SUPPLEMENT, No. 1293, has many interesting articles, including a number of important addresses, as the "Inaugural Address of Prof. Sir William Turner," "A Report of the International Psychological Congress," "The Opening Address of the Department of Astronomy," by Dr. A. A. Common, "Mechanical and Technical Education in the United States," by Prof. C. F. Chandler. "The Automobile in Modern Warfare" is a fully illustrated article, showing many interesting types. "The Nobel Prizes for Scientific Discoveries" gives the complete rules and regulations for this competition. "The Last Day of a Farm House at Pompeii" is a most highly interesting archæological article.

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RECENTLY PATENTED INVENTIONS.

Hospital Appliances.

INVALID-BED AND LIFTING DEVICE FOR HOSPITAL-BEDS.—DR. ELBERT E. MUNGER, Spencer, Iowa. Medical men and nurses have long sought a bed so constructed that it could afford the patient every personal comfort and at the same time serve as an assistant to the nurse or attendant, so that the patient, regardless of the cause or nature of his illness, could be easily nursed without undue labor. Beds have been devised which have met some of these requirements. The Munger invalid bed is designed to meet them all. Dr. Munger's invention consists briefly of a strong bed-frame with an ordinary woven-wire spring-mattress, the frame of the latter being transversely pivoted near the center. The movement thus rendered possible permits a depression of the head and trunk in cases of narcosis, or elevation to a semi-sitting posture. When the patient is swung to an upright position, a downward sliding is prevented by a seatboard placed between the hair and woven-wire mattresses. To the seat-board two foot-pieces are attached, each working independently and so adjusted that one or both of the lower limbs may be placed at any desired height without regard to the position of the trunk. A longitudinal central slot in the hair-mattress permits the introduction of a bed-pan. The bed is further supplied with lateral, revolving, side bars or shafts to which broad bands may be attached. The bands are to be passed beneath the patient to raise him in order to facilitate change of bedding. With this bed, fractures followed by long confinement may be treated. With the seat-board in position, the bed may be readily converted into an upholstered chair form and the patient relieved of the strain of a long-continued lying posture. The simplicity of this bed's construction and the ease of operation earned for it a medal at the Paris Exposition, although it had not been the inventor's intention to compete for any prize.

Agricultural Implements.

HAY-RAKE.—JAMES H. HUGHES, Alicel, Ore. This horse hay-rake is so constructed that the teeth can be adjusted to or from the ground and held normally from the ground through the medium of a tension device connected by a lever with the head of the rake. When the lever is not in engagement with a rack provided to hold it in certain positions, the tension device will sustain the rake-head in an upper position. Mr. Hughes has made and sold a number of his machines. The invention has proven a practical success.

BAND-CUTTER AND FEEDER.—WALFRED C. PETERSON, Geneva, Neb. By means of this device, the feed of the cylinder and concave are automatically governed and are of such character as to render it impossible for an excess of material to clog the cylinder. When such a condition is likely to prevail, the bundle-carrier and feed-roller employed will instantly and simultaneously stop, being automatically set in motion again as soon as the conditions are normal. Knives are provided for cutting the bands. These knives have a drawing motion in the direction of the cylinder, so that the straw cannot be wrapped around them or their carriers.

Mechanical Devices.

BARREL-OPENER.—JOSEPH A. BERONIO, Memphis, Tenn. The purpose of this invention is to provide a device for removing the top hoop of a barrel, which device can be used with equal facility whether the head be in the barrel or not. The device consists of a hand-lever, provided with a hook adapted to engage the hoop. The lever is fulcrumed on a link carried by a foot designed to rest on the barrel-head.

ORE CRUSHER AND AMALGAMATOR.—LOUIS JACQUES, Telluride, Colo. The ore crusher and amalgamator comprises a sliding and rocking muller movable in a mortar. As the muller approaches the end of the mortar, it will be so tilted as to leave a space between its bottom and the ore on which it is operating, so that the ore is washed underneath by the water in the mortar. The metal crushed and washed out of the ore is gather d in the mercury box with the mercury.

VARIABLE-SPEED GEAR.—ERNST LANG, Brussels, Belgium. The gear is of that class in which there is provided an expanding pulley whose diameter can be gradually varied. On a rotary disk levers are pivoted, provided with belt-engaging devices and means for turning the levers to move the belt-engaging devices toward or from the axis of the disk.

Railway Contrivances.

JOINT FOR PORTABLE RAILWAYS.—ALPHONSE H. AILLOUD, Merida, Mex. This joint for portable railways is designed to decrease the amount of material used in each section without, however, diminishing the strength of the structure, and at the same time to reduce the cost and price of workmanship to the manufacturer without prejudice to the quality of the product. The improved joint has all the merits of the so-called "hybrid" joint with none of its defects, and is adaptable to curves, switches, crossings, turn-plates, and other rail accessories.

SEAL-LOCK.—HENRY M. GROVER, Wallingford, Vt. The seal-lock comprises a keeper engaged by a latch provided with a seal-receiving depression. A bolt locks the latch and keeper together, the seal being held in place by the keeper and the latch engaging with its periphery. It is impossible to pick or open the lock without first breaking the seal.

NUT-LOCK.—HON. J. D. DOWELL and LAWRENCE M. GALLIHER, Mineola, Tex. The lock consists of a flat base plate having an arm extending from one corner, offset to a different plane, bent over with a gradual curve, and returned to the base-plate upon the opposite side from which it started. The construction gives elastic spring to the notched arm, adapts it to nuts of different sizes, and reduces the cost of manufacture.

Vehicles and Their Accessories.

MOTOR-VEHICLE WHEEL.—CALEB G. ENSIGN, Madison, Ohio. The wooden hub of the well-known Sarven wheel carries the box, and the peripheral surface of the hub is covered with metallic bands bolted together at their flanges, the bolts passing through the joint of the adjacent spokes. The use of this wheel on motor-vehicles necessitates some changes to prevent the loosening of the hub and of the flanges. To avoid these dangers and to construct a wheel in which the metallic box and the metallic covering of the hub are firmly united to give rigidity to the wheel is the object of the invention.

WHEELBARROW.—JASPER B. WILLSEA, Denver, Colo. The handles or side bars of the wheelbarrow have their forward ends curved upward and forward to form striking-bars and to support the edge or flange of the tray. The wheel has its axle-bearings in the side bars between the ends of the body or tray. A hood in the body extends over the wheel to prevent contact of the load with the wheel. The wheel is so arranged that the load upon the handles is partly counterbalanced, thus relieving considerably the pressure on the handles.

DRAFT-EQUALIZER.—JOHN F. SMITH, Parker, S. D. This draft-equalizer comprises a main lever having a long arm projecting on one side of its fulcrum; a second compounding lever arranged closely to the first and provided with an enlarged head fulcrumed behind the first-named lever. A link connects this lever immediately behind its fulcrum with the outer end of the main lever-arm. A draft-lever is attached to the end of the rear or compounding-lever and is arranged on the opposite side of the fulcrum of the main lever from its long end. The invention is distinctive in its simplicity.

AXLE.—WILLIAM C. DALZELL, Egremont, Mass. The invention relates particularly to axles for vehicles in which the wheel-spindle swings on the axle, as in automobiles; and the object is to provide movable hard-metal bearings with simple means for adjusting the bearings as they become worn. The means in question consist merely of a king-bolt which serves as a pivot for the spindle, and a nut which screws on the bolt and serves to take up the wear. The adjustment can be made without removing the wheels or spindles.

Miscellaneous Inventions.

LETTER-SHEET.—SPENCER CLAWSON, Salt Lake City, Utah. The inventor has provided a letter-sheet and envelop so combined that a letter may be written and the sheet conveniently severed from the envelop, so as to be placed therein, the object being to promote convenience in the conduct of extensive business correspondence, and especially in connection with type-writer work.

DIGESTER.—EDGAR G. MURPHY, Sandy Hill, N. Y. Wood-pulp digesters used in making paper have been made with linings of cement extending in an unbroken layer. By reason of their expansion and contraction, such linings readily crack. The essential feature of the present invention lies in the building of the digester-shell with butt-straps having inwardly-projected portions, at the sides of which the cement lining is placed in separate and independent sections, the butt straps performing the double function of protecting the seam in the shell and of breaking the continuity of the cement.

DOOR-LOCKING DEVICE.—INGWER F. REDLEFSEN, Texarkana, Ark. Mr. Redlefsen has devised an ingenious method for simultaneously unlocking or releasing a number of doors, such as sliding-doors for cars, residences, barns, cells, or the like. The principle of the invention lies in the use of compressed air or steam for operating the latches of the doors. The steam or air can be controlled from any desired point.

PICTURE-FRAME.—HERMAN DAVIDSON, Manhattan, New York city. To provide a simple means for securing the back of the frame is the object of this invention. The back has a spring-yielding peripheral flange adapted to enter underneath the flange of a retaining-strip extended along the upper portion of the sight-opening of the frame. The back has spring-yielding engagement with a clamping-strip arranged along the lower portion of the sight-opening.

SUPPORT FOR MINERS' LAMPS.—CHRISTIAN J. HECKEL, Pittsburg, Penn. The support comprises a wire frame bent to fit upon the miner's cap, and provided with an eye to receive the hook of the lamp. A segmental guard projects horizontally forward between the members of the frame and in front of the eye. The lamp-body rests in a socket on the lower portion of the frame.

BUTTON.—HENRY HIRSCHBACH, Manhattan, New York city. The button consists essentially of a head and a shank made in two sections pivoted together. The pivoted section is forced into the garment and swung into a right-angular position relatively to the other section, to prevent the withdrawal of the button. The sections are locked in their relative positions by spring-jaws.

LOCK.—HENRY L. KELLOGG, Stevens Point, Wis. This invention is a combined lock and door-knob. The lock has very few parts, thus reducing the cost of manufacture, and is not likely to get out of order. The lock is easily placed in a door, merely by cutting a mortise in the wood.

QUILTING-FRAME.—LUCINDA A. WOLFE, Webb City, Mo. The quilting-frame is of that class which are adapted for self-support upon the floor and for lateral adjustment for taking up a quilt as the sewing progresses. In this invention means are provided for adjusting the parts on which the side or quilting-carrying bars are supported, and for adapting the principal parts of the apparatus to be detached from one another, so that they may be packed or stored in small space.

HOSE-COUPLING.—RUFUS WILLIAMS, Walla Walla, Wash. In this device the coupling-collars may be reciprocally used—that is, either can be screwed on the ferrule of the other abutting section of hose—so that time otherwise lost in selecting the right collar will be saved, which is especially desirable at a fire or on other occasions when quick attachments are necessary.

PROJECTING APPARATUS.—FRANK J. ADAMS, Manhattan, New York city. Mr. Adams has hit upon the novel idea of employing both incandescent and arc lights in his apparatus, with the result that he secures good definition in the projected picture, and obtains a mellow light. The highly-illuminated object in the rear of the casing is refracted by the lenses so as to appear in its natural colors, the lenses being protected from the lamps since the latter are grouped around the casings of the lenses.

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Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7972) L. C. G. asks: 1. Where is the proper position for a violin bridge? Some say 13 inches from end of fingerboard, and some say opposite the notches in sound holes. Which is right? A. The usual position of a bridge on a violin is exactly between the small nicks marked in each sound hole. 2. What is the function of the sound-post and bass bar of a violin, and what is the rule for adjusting the former? A. The position of the sound post is usually 1/8 to 3/8 of an inch behind the right foot of the bridge, the distance being variable according to the model of the instrument. If the violin be high built, the post requires to be nearer the bridge, that its action may be stronger, while flat-modeled instruments require the post to be set further away from the bridge. The sound post is the medium by which the vibratory powers of the instrument are set in motion, it gives support to the right side of the belly, it transmits vibrations and regulates the power and quality of the tone. The sound bar facilitates the vibration. 3. Would it be an advantage to wind the permanent magnets of a Clarke machine, as described in the SCIENTIFIC AMERICAN of December 3, 1881, and if so, how would you send the current through it—from a separate battery or switch off a part of the current from the machine? A. The machine in our issue of December 3, 1881, is a magneto generator. A dynamo with electro-magnets is a better machine of course. If you wish to build a dynamo, you would better find plans for such a one as you wish and start new, rather than to attempt to alter a design as old as this one. A machine built in 1881 is a very ancient affair. 4. How would you determine the voltage and amperage of the foregoing? A. The volts and amperes in a dynamo are found by a volumeter and an amperemeter. 5. Where can I procure a register of United States naval officers and vessels and their respective stations? A. The Army and Navy Journal gives the news of the service.

(7973) C. I. G. asks: 1. Can the electric furnace described in SCIENTIFIC AMERICAN SUPPLEMENT, August 27, 1898, be used on a 104 volt alternating current? A. The electric furnace can be used with any sort of current. 2. Do you publish an index of contents of the SCIENTIFIC AMERICAN SUPPLEMENT, for a few years back? A. Yes.

(7974) W. C. M.—The proportions in the formula on page 186 of September 22, 1900, issue are about right. The two upper formulæ on page 92, August 11, would make solutions too dilute.

NEW BOOKS, ETC.

CYCLOPEDIA OF AMERICAN HORTICULTURE. By L. H. Bailey. Assisted by Wilhelm Miller, Ph.D. Illustrated with over 2,000 original drawings. In four volumes. E–M. New York: The Macmillan Company. London: Macmillan & Company, Limited. 1900. Quarto. Pp. 511 to 1054. Price $5.

Some months ago it was our privilege to review the first volume of this work, and at that time we commented favorably upon the plan and scope of the work. The second volume does not differ materially from the first, except that the subject is now carried down as far as the letter M. Some of the illustrations are not quite so well reproduced as they might be, but on the whole the book is very satisfactory. The author seems to have a remarkable facility in knowing just what the reader wishes to obtain from a book of this kind. The volume is a handsome one and would adorn any library.

PRACTICAL CARRIAGE AND WAGON PAINTING. By M. C. Hillick. Chicago: The Western Painter. 1900. Pp. 161. Price $1.

This is a full treatise on the painting of carriages, wagons and sleighs, embracing full and explicit directions for executing all kinds of work, including painting factory work, lettering, scrolling, ornamenting, varnishing, etc., with many tested receipts and formulas. The book is profusely illustrated, and the new edition will prove of great value to all carriage painters, even though they may already be competent mechanics. The book contains many excellent designs.

THE ANTARCTIC REGIONS. By Dr. Karl Fricker. London: Swan Sonnenschein & Company, Limited. New York: The Macmillan Company. 1900. 8vo. Pp. 292. Illustrated. Price $3.

At the present time Antarctic exploration divides the field of interest with Arctic exploration. The fact that the extreme South is not at all well known lends more than ordinary interest to the subject. A number of expeditions are now on their way to discover, if possible, the South Pole. The book is very readable and is admirably illustrated.

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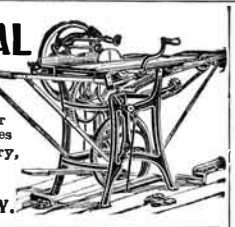

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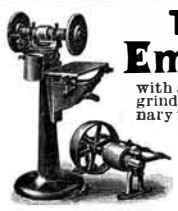

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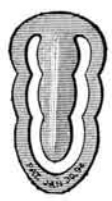

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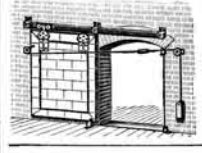

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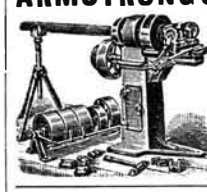

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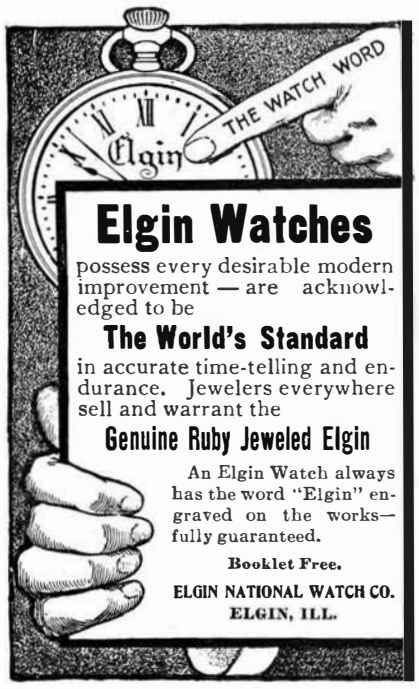

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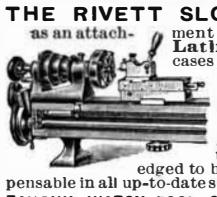

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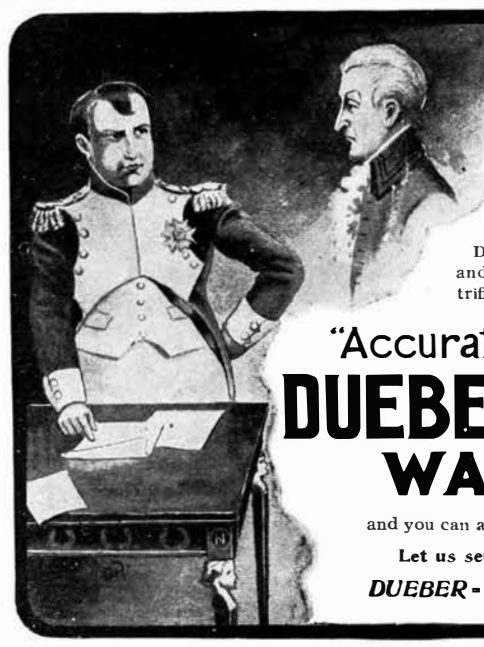

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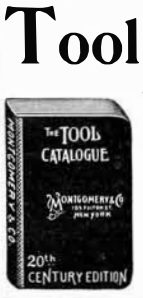

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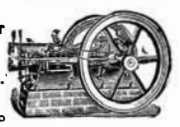

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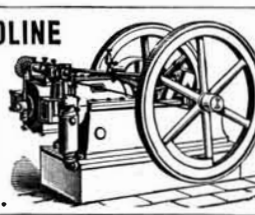

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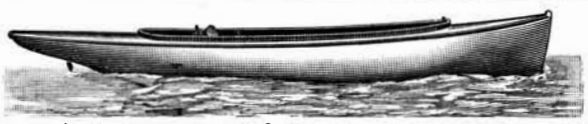

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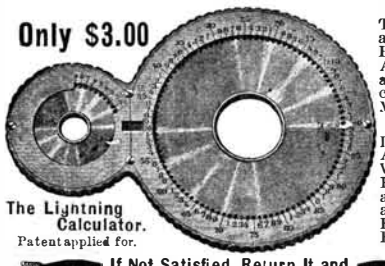

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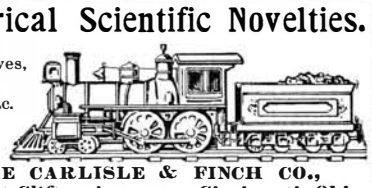

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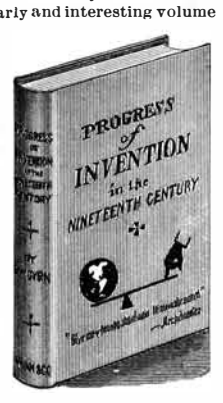

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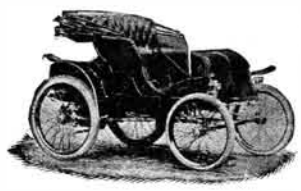

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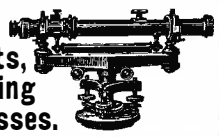

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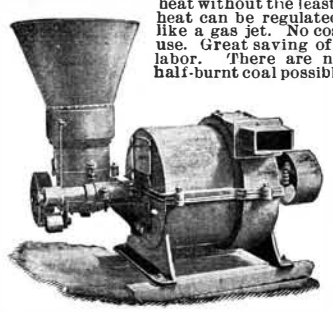

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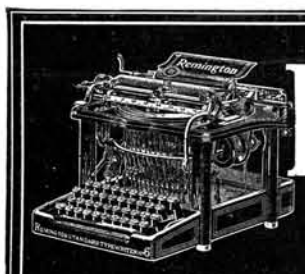

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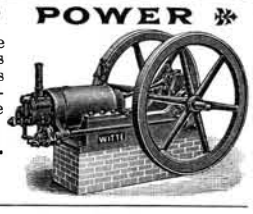

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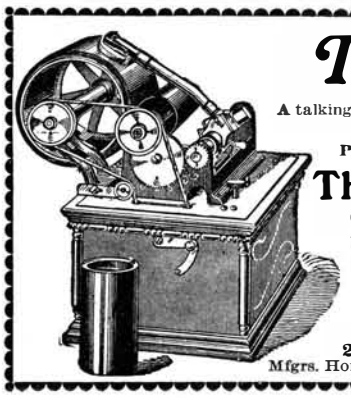

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